Medieval Matching Markets

Lars Börner
Daniel Quint

School of Business & Economics
Discussion Paper

Economics

2010/31

978-3-941240-43-8

Medieval Matching Markets

Lars Boerner
Department of Economics
Free University Berlin
lars.boerner@fu-berlin.de

Daniel Quint
Department of Economics
University of Wisconsin
dquint@ssc.wisc.edu

Draft: December 10, 2010[1]

[1]The authors thank Paul David, Oscar Gelderbloom, Yadira Gonzalez de Lara, Avner Greif, John Hatfield, Randolph Head, Ramon Marimon, Muriel Niederle, Albrecht Ritschl, Battista Severgnini, Oliver Volckart, and Hermann van der Wee for encouraging discussions and comments. We have benefited from comments of participants at conferences at the All-UC Economic History meeting 2006 (UC San Diego), the European Economic Association Meeting 2008 (Bocconi University), the Economic History Society Annual Conference 2006 at the University of Reading, and seminars at the European University Institute, Humboldt University Berlin, London School of Economics, Stanford University, and University of Utrecht.

Abstract

This paper studies the market microstructure of pre-industrial Europe. In particular we investigate the institution of the broker in markets and fairs, and develop a unique data set of approximately 1100 sets of brokerage rules in 42 merchant towns in Central and Western Europe from the late 13th to the end of the 17th century. We show that towns implemented brokerage as an efficient matchmaking institution in a two-sided market problem. Furthermore, towns differentiated *seller-friendly* from *buyer-friendlier* matching mechanisms. We show that the decision to implement matchmaking mechanisms, and whether these mechanisms would be buyer- or seller friendly, depends on the products in question and the stated policy goals of the town, as well as time and geographic variables.

Keywords: preindustrial markets, market microstructure, efficient matching

JEL classification numbers: D4, N23

1 Introduction

Late medieval Europe was characterized by a revival of inter-regional trade (Lopez 1976). Merchants traveled from their home towns to other cities to sell and buy goods. Beginning in the Late Middle Ages, this rise of long distance trade contributed to increased urbanization rates and the growth of merchant cities – starting in the Mediterranean area at the beginning of the 11th century, and north of the Alps in Central and Western Europe about a century later (Bairoch et al. 1988).

The rise in the exchange of goods created a need for institutions which would match the supply of goods by foreign merchants with the local demand(Verlinden 1971). A merchant entering a foreign city had to find buyers interested in the specific type and quality of goods he carried. But the process of searching and matching is accompanied by a problem of strategic interaction between buyers and sellers. A merchant wanting to sell at the highest possible price has an incentive to overrepresent the cost of the goods or the prices he is willing to accept. Similarly, buyers have an incentive to underreport their maximum willingness to pay. Each is motivated by the hope of receiving a higher share of the surplus being generated by trade. Since foreign merchants had only limited time available to search, bargain and transact, information asymmetry and strategic behaviour could lead to mismatches between buyers and sellers. The consequence of such mismatches is a reduction in the gains from trade, or a loss in welfare.

In response to these problems, towns began to experiment with market making activities or, more generally speaking, with various allocation and market clearing mechanisms. These included regulations on bilateral bargaining; intermediation; spot markets; and auctions. One important element was the introduction of licensed brokers for different wholesale and factor products in most of Europe's merchant cities. Brokers were instrumental in the process of searching and matching, especially between foreign sellers and the retailers and craftsmen who made up the local demand.

In this paper, we examine the details of how brokers were introduced and regulated during this early phase of pre-industrial city growth, from the 13th to the 17th century. The questions we ask: Is there a general pattern, or did brokerage in each city follow its own context-specific evolution? What brokerage mechanisms were used? What were the welfare properties of these mechanisms, and how did they divide the gains from trade among buyers and sellers? Were their properties linked to the stated policy goals of the merchant cities? And finally, based on this market design analysis, does this help to explain why early capitalistic Europe developed so well?

Economic and legal historians who have studied brokerage in this period have focused on descriptive case studies of individual towns – for example Gilliodts-van Severen 1881, Ehrenberg 1884, Frensdorf 1901, Toebelmann 1911, Schmieder 1937, and Schubert 1962.[1] Their contribution is the discovery of the first source material and the identification of individual regulations. Their focus was on an all-embracing historical identification of brokerage. From an economic point of view they identified brokerage as a multifunctional institution which performed commercial intermediation, certification of the quality of goods, tax collection for the town, and the notarization of deals. A comprehensive quantitative analysis of the evolution of brokerage so far is missing, as is a formal institutional incentive analysis or an evaluation of brokerage as a form of market design. Scholars of medieval market mechanisms have tended to focus on the monopoly power of guilds on local retail and export markets (Swanson 1988, Munro 1990, Hickson and Thompson 1991; Epstein 1998; Richardson 2003). Their main findings are that monopoly power of guilds was rather limited; although some guilds had limited monopolies on good production in their home towns, the selling on local markets was competitive, and exchange of products between towns was open and led to competition. This was true both for raw and finished products in regional and long distance trade. Another line of research by Avner Greif and others (Greif 1993, 1994, 2002; Greif et al. 1994) has examined the institutions that enabled credit transactions and impersonal exchange on medieval markets. The key issue in this line of research is overcoming the commitment problem among groups of merchants in long distance trade. Solving this commitment problem is a necessary precondition for the marketmaking activities considered in this study.

Analysis of intermediaries has a long tradition in market microstructure theory. Spulber (1996) concludes that intermediaries improve the welfare of consumers and suppliers by reducing or eliminating the uncertainty associated with searching for a satisfactory match. Transactions with recognized centralized intermediaries can supplant decentralized search and bargaining, so that customers and suppliers avoid the costs of decentralized search. In addition, trading through a broker may offer "high-value" traders a greater chance of trading and more favorable expected prices.

[1] For a survey of some of the findings of the early literature see van Houtte (1936). For a synthesis of these findings for some Dutch towns see Gelderbloom (2009).

Gehrig (1993), Yavas (1994), and Neeman and Vulkan (2005) present models where buyers and sellers choose between using a centralized intermediary or trading through decentralized search and one-on-one negotiations. In both papers, traders with the highest gains from trade (buyers with high willingness to pay and sellers with low costs) prefer trading through the centralized mechanism, as they receive more favorable prices on average. Rust and Hall (2003) present a similar model of entry by profit-seeking market makers into a market relying on decentralized trade via middlemen; in their model, the market maker must publicly post bid and ask prices, allowing the decentralized middlemen to undercut them. Their results are similar to Gehrig: high-gains-from-trade traders transact through the market maker, and intermediate-gains-from-trade traders use decentralized search. Yavas (1992) considers brokers' choice of whether to act as matchmakers (pairing buyers to sellers) or marketmakers (explicitly buying and selling goods). He finds that if search is efficient and costless, intermediaries prefer market making; if search is cost-intensive and inefficient, intermediaries instead opt for matchmaking.

Another line of research has concentrated on the explicit modeling of market-clearing mechanisms and algorithms in two-sided matching markets (Roth and Sotomayor 1990; Roth and Rothblum 1999; Roth 2008: Niederle and Roth 2003; Yavas 1994). Roth and others argue that centralized markets or clearinghouses can be welfare improving and efficient. However to be so they must create sufficient market thickness, overcome problems of congestion which can come up in thick markets with many alternative transaction options, and minimize strategic behaviour of agents participating in the mechanism. Both congestion and strategic behaviour can lead to mismatches and welfare loss. This in turn can reduce the interest of individuals to participate in a clearinghouse, which again reduces market thickness. Thus the solution is to find centralized clearing mechanisms which create efficient matches. Separate from this strand of literature, Yavas (1994) has looked into different forms of intermediation and finds different matching outcomes based on different intermediation designs and compensation structures.

This paper focuses on the analysis of actual mechanisms used historically to match buyers to sellers, and on the strategic behavior of the merchants and brokers involved. Thus we follow the second strand of theory literature which deals with the implementation and market microstructure of centralized clearinghouse mechanisms.

The hypothesis advanced in this paper is that merchant cities implemented brokerage to increase the combined welfare of the local demand and foreign supply sides of the market. This was done by giving brokers incentives to create matches (based on the reported preferences of the merchants). In addition, the regulations were implemented in such a way to minimize the strategic behavior of merchants, which in turn could lead to mismatches and welfare loss. We show that towns differentiated between *seller-friendly* and *buyer-friendlier* matching mechanisms: in the seller-friendly mechanism, the broker had an incentive to give more surplus to the seller; in the buyer-friendlier mechanism, a broker was free to choose how he would split the surplus between the matching pair of merchants.[2] The implementation of seller-friendly mechanisms made markets attractive to foreign sellers and reduced the seller's incentive to strategically misrepresent his preferences. Buyer-friendlier mechanisms were more attractive for the local buyers, but increased the strategic behavior of the sellers. Since the broker normally came from the local demand side, the information asymmetry was strong between the foreign seller side and the broker, and not between the local buyer side and the local broker. Towns therefore faced a trade-off between giving more surplus to the foreign sellers, reducing the strategic behavior of the foreign sellers and thus increasing the aggregate welfare, or giving more surplus to the local buyers, but increasing the likelihood of strategic behavior and reducing aggregate welfare. Whether a town implemented a brokerage mechanism at all, and if so whether it was buyer- or seller-friendlier, can be partly explained as a function of the product market in question and the complementary policy goals stated in the town's regulations. Time and geographical effects also help to explain the implementation decision.

To achieve this conclusion, in the first step we created a data set of 1,106 sets of regulations from 42 towns in Central and Western Europe from the late 13th to the end of the 17th century. We identify and focus on particular combinations of regulations found in many cities over these four centuries. We show that merchant towns implemented brokerage as a product-specific centralized matchmaking function. In the second step, we take these regulations and place them into the framework of a two-sided matching model. We follow here a modeling tradition established by Roth and Sotomayor (1990) and others. We examine the incentives of the brokers in how they match buyers and sellers, and the strategic behavior of the merchants

[2] This is why we call the mechanism buyer-friendl*ier*, because it is relatively buyer-friendlier compared to the seller-friendly mechanism.

who interact with the brokers. This way we derive the equilibrium results for the identified mechanisms. In the third step, we run binary logit regressions where we take the matchmaking designs found as dependent variables; as the main explanatory variables we take the product in question and the policy goals stated in the town's regulations. In addition, we control for time, geography, and city size. Finally, we discuss the theoretical predictions and empirical results in their historical context. This three-step methodology applied is based on Greif (1993, 2006), and Greif and others (1994). Our analysis extends the third step of this approach by generating econometric quantification first, and then going beyond discussing single case studies in the historical context.

This paper contributes in three ways. First, it offers a comprehensive study of brokerage in Europe from the Late Medieval to the Early Modern period. It reveals the evolution of market microstructure in pre-industrial Europe. Second, by applying matching theory, we shed light on the strategic interaction of the agents transacting through brokers, and therefore on the functioning and role of brokerage as a market-clearing mechanism. This way we can show how market designers in the past solved incentive problems and created efficient market platforms. Finally, we can contribute to the debate on pre-industrial growth and the first divergence of Europe (Pomeranz 2002). We can show that Late Medieval and Early Modern merchant cities in the area of investigation created surprisingly homogeneous formal institutional solutions to incentive problems and implemented welfare-generating market designs. In this way, an important part of the institutional foundation was laid, which made the pre-industrial growth of the early modern city possible. This underscores the importance of formal institutions for further economic expansion and growth (North 1981; Acemoglu et al. 2005; Greif 2006).

This paper focuses on the institution of brokerage and its welfare and policy properties. The question why we find this and not other forms of intermediaries or (de)centralized trade must be left for analysis in a separate paper. In addition, questions of the evolution of the mechanisms found and detailed learning behavior of towns in the historical context must be studied elsewhere. Finally, the role of other economic aspects of brokerage such as certification, notarization, or tax collection, must be studied in another paper.

The remainder of the paper is structured as follows. Chapter 2 introduces the historical environment and the informational problem that merchants faced. Chapter

3 discusses the data found, that is, the brokerage regulations that merchant cities implemented. Chapter 4 presents a formal institutional analysis: it looks into the incentive problem of the broker and the merchants and predicts outcomes based on the regulations in place. Chapter 5 undertakes an empirical analysis and discusses how the empirical and theoretical outcomes of the model relate to the observed historical market context.

2 City growth, Trade, and Information Asymmetry

The sample of brokerage regulations analyzed in this paper is a comprehensive source investigation which covers most data available from the late 13th to the 17th century in Central and Western Europe north of the Alps.[3] The map in figure 1 shows in which cities brokerage regulations can be documented.[4] This captures the most important merchant cities, including Amsterdam, Antwerp, Augsburg, Brugge, Cologne, Danzig, Frankfurt, Hamburg, Leipzig, and Strasbourg.

Let us first describe the historical environment of these cities in their broader economic historical context. At the beginning of the 11th century, Europe entered a period of economic expansion and population growth. This started in the Mediterranean area and later spread north of the Alps during the 12th and 13th centuries. The population growth was strongly interlinked with the foundation of towns and increasing urbanization (Bairoch 1988). Among the cities north of the Alps in our

[3] No sources before the late 13th century have been preserved. More data is available from the 18th century, but we chose to focus on the earlier period.

[4] The sources are compiled of edited and non edited sources based on several thousand pages of source material, which have been translated and analyzed by us from different mainly medieval Germanic dialects. The geographic area of investigation is broadly the German Reich within its 1550 boarders north of the Alps. We analyzed all edited sources available for the period of investigation and complemenetary archivial material, which was mentioned in the edited documents or secondary literature. Additionally, we checked for documented archival material in all cities in the area of investigation mentioned in Bairoch et al. 1988. Whereas the material is to the best of our knowledge rather complete (relative to what has been preserved) until the beginning of the 17th century, there is likely more material available in archives in particular for the second half of the 17th century. The composition of our sample of brokerage regulations reflects the survival and accessability of the sources, not a conscious selection on other bases.

sample which contributed to this early growth were Augsburg, Brugge, Cologne, and Ypres, which by 1300 already had tens of thousands of inhabitants. However, most cities, for example Frankfurt, Danzig, and Leipzig, were smaller and grew from a few thousand to a comparable size only later during the 15th and 16th century. This phase of growth was only briefly interrupted by the outbreak of the Black Death around 1340, which led to a temporary decline of the population; population growth regained its momentum again during the 15th and 16th centuries. The increase in urbanization was caused by the so-called Commercial Revolution, which was an intensification of trade among different regions of Europe (Lopez 1976). This comprised not only trade within the Mediterranean and Baltic/ North Sea area but also continental land trade between northern and southern Europe. With the discovery of the New World, the transatlantic trade started to become relevant during the 16th and in particular the 17th century. Western areas, and especially towns with access to transatlantic trade, grew even more rapidly (Bairoch 1988, Bairoch et al. 1988, Acemoglou 2005). The cities in our sample which profited most were Dutch cities, most notably Amsterdam but also the German cities of Hamburg and Bremen.

The driving force of city growth was the expansion of interregional long distance trade, whereby merchants traveled to foreign cities to trade goods. In this way, a large variety of different products of heterogeneous qualities was traded: textiles and clothing products, dyes and spices, basic foodstuffs like grain, fish or wine, and finally construction materials and metals (Postan 1965, pp. 168-178, Kellenbenz and Walter 1986, p. 867ff., Kellenbenz 1986, pp. 262-71).

Due to the ongoing population growth of cities and the variety of products traded, arriving merchants were faced with strong information asymmetry about their potential trading partners. Given the value of information, then, we would expect a sort of market for information to arise. This could take the form of a variety of institutional solutions to solve the information problems. Indeed, we do observe a multiplicity of institutions evolving during the Late Middle Ages to serve these needs. The most important are intermediation in the form of brokerage and the organization of spot markets (including warehouses). Both of these were organized and tightly controlled by the town officials of the merchant cities. In this paper, we focus on brokerage; the organization of spot markets and warehouses must be left for another study.[5]

[5]No systematic study exists which discusses the development of spot markets or warehouses. Some single case studies exist which deal with some aspects of the market microstructure of sin-

Another institution we might expect to arise are auctions. However, auctions were rare through much of the period and areas we investigate, and begin to play a more important role as clearing mechanisms only at the start of the 17th century.

Another potential solution we would expect is for traveling merchants to start having partnerships, where one partner is permanent in a foreign city. Such partnerships developed only gradually with the evolution of the first firms (de Roover 1971, pp. 70 ff.; Hunt and Murray 1999, Boerner and Ritschl 2009). Such branches can be found only in a few cities in the area of our investigation, and more frequently during the end of the investigation. Examples could be found for some factories of Italian firms during the 14th and 15th century in Brugges, or branches of south German firms as the Fugger Company during the 15th and 16th centuries in Antwerp (de Roover 1965, Kellenbenz 1990, Schneider 1989). These companies provided information flow based on internal postal services.[6]

Public price information of goods traded was also not available. Although informal lists circulated earlier, the first public market price lists were not available before the end of the 16th and early 17th centuries for some selected goods, which were produced by the brokers based on their experiences during the previous trading week (McCusker and Gravensteijn 1991).

Before we go into a more systematic analysis of the organization of brokerage, we discuss some stylized facts about brokerage. The broker typically served as an intermediary between foreigners and locals; intermediation between foreigners and foreigners developed only gradually, in particular during fairs. Brokers primarily matched foreign sellers with the local demand side in the form of retailers and craftsmen. (Foreign merchants who came to a town to buy typically relied on other institutions.) Local sellers often ran common warehouses or grouped their stalls or selling locations on the same street or square, so that foreigners knew exactly were to find a particular product genre.[7]

gle individual towns, for example see Reyerson (2002) for a case study of medieval Montpellier or Kuske(1913) for Cologne. Another line of research on the aggregate level by Cantoni and Yuchtmann (2009) provides evidence on the importance of market making activities by showing the complementary evolution of foundations of towns and the granting of market rights to these places by local dukes.

[6]Public messenger services served information flow between town officials and did not carry business information (Gerteis 1989).

[7]For example see the example of Cologne (Kuske 1913). Product grouping could also sometimes be found by foreign sellers during fair times: for Frankfurt see Brübach (1994) and Rothmann (1998). However, a comparative analysis of different institutional solutions so far is missing.

The existence of informational asymmetry and the potential strategic use of information was well understood at the time, and is well documented in various towns' brokerage regulations. Regulations required brokers to be silent about price information and the preferences of merchants related to prices. They were not allowed to inform buyers or sellers about earlier price formation – for example, the broker could not tell a buyer the price the same seller had charged in an earlier deal. The broker was also not allowed to inform the buyer if the seller was in a hurry to sell his goods, nor tell the seller if the potential buyer was rich or poor. Clear examples of such statements can be found in brokerage rules from Frankfurt 1406 and 1465 (Buecher, pp. 211ff. and 213ff.) or Cologne in 1427 (Stein II, p.235). From these sources we can clearly see that informational asymmetry was known to exist, and that there was space for strategic behavior. If a seller learned from a broker that a buyer could afford to pay a high price, he would have a stronger incentive to overreport his own reservation value; if a buyer learned about past prices, or that the seller needed to sell his goods quickly, he could understate his own willingness to pay. The brokerage regulations from Schlettstadt from the early 16th century gave exactly this second reason for ordering the broker's silence (Geny 1902, p. 988-9). Furthermore, there is plenty of evidence that brokers could potentially have used their knowledge to make private deals, which was therefore generally forbidden. We will elaborate on this type of regulation in detail in the next section. The importance of this last point is nicely documented in a letter from the Hanseatic League to Brugge in 1438. Merchants from the Hanseatic League had earlier left Brugge, and were negotiating over returning to Brugge to do business. Among other demands, they wrote that they only would come back if the city could guarantee that brokers did no private business for themselves (Hoehlbaum et al. 1876-1939, Hansisches Urkundenbuch, VII n. 389 § 5).

The importance and conscious implementation of brokerage regulations can be documented in many sources, which reveal not only regulations and related policy goals, but also reflections about the regulations put into practice. In one source from Cologne, an expert probably ordered by the city of Cologne evaluates different market making activities and regulations, including brokerage regulations. The report concludes that the brokerage regulations in use are good and should be kept (Stein II, 1893-5, pp. 565f.). Towns also consulted other cities about the use of brokerage regulations. Leipzig, a city which only started growing during the 15th and 16th century, asked Frankfurt and probably other cities for advice on brokerage regulations in 1613. Frankfurt replied and sent their regulations to Leipzig, and also referred to brokerage activities in Cologne, Hamburg, and Nuremberg (Moltke 1937 p. 15f.).

3 Brokerage regulations

3.1 Origin, City Size and Product Genres

Let us in a first step describe when and where the first brokerage regulations could be found. Figure 2 shows the year in which the first regulations were documented in each city, along with the population of the city at that time. Most cities had between 5,000 and 20,000 inhabitants when the regulations were first documented. The exception is the early period, where towns were larger than average when brokerage rules were first documented; this is likely because earlier sources are missing. Towns like Brugges, with 40,000 inhabitants, very likely had brokers already before 1252. However from later periods where more documents have been preserved, towns were smaller when they first appear in our data. For example, around 1349 Frankfurt had 13,000 inhabitants, and around 1495, Amsterdam had approximately 15,000 inhabitants. Once regulations were enacted, recurring records can be documented in which continuous source material could be found. Nonrecurring observations can mainly be shown for small or non-growing towns.

Next, we describe the goods for which brokerage regulations can be found. Of the 42 cities for which we found regulations, we have information from 34 about the products for which brokers were used. Table 1 shows product categories which were found in at least one-third of these cities. Most frequent were regulations for fish, raw textile, cloth, wine and beer, oil and fat, financial products, fur and skin, metals, spices, grain, horses and property. All categories in Table 1 could be found before 1300 in the regulations from Brugge (in 1252) and/or Augsburg (in 1276). This was still the case during the 17th century, for example in the documents from Amsterdam or Hamburg. What changes are the specific products found. For example, in the category of financial products, the number of regulations about bills of exchange increased over time, and stocks appear for the first time in Amsterdam (in 1623) and Hamburg (in 1643).[8]

[8] A comprehensive mapping of the evolution of all products would be beyond the scope of this paper and must be studied separately.

3.2 Regulations

What regulations were implemented? Towns used brokerage as a centralized clearinghouse: a small number of licensed brokers had the exclusive right to match buyers and sellers. Other forms of intermediation were in general not allowed.[9] With a few exceptions, merchants were generally free to use a broker or to search on their own for trading partners. We code brokers having the exclusive right to act as intermediaries as *only_brokers*, and the cases where merchants were required to use a broker as *forced_brokerage*; Table 2 shows how frequently each of these regulations appear in the data. A broker was licensed for a specific product genre: for example, in Cologne in 1407 we find three brokers for wood. Towns limited the number of brokers in each product genre to a few. In some cases, when there were more brokers, towns forced brokers to share the gains equally. (For example, in regulations from 1407 and 1427, the wood brokers from Cologne had to share profits.) Brokers usually came from the local demand side; only in exceptional cases did the documents reveal that foreign merchants could bring their own brokers.[10]

How were brokers compensated? Brokers were not allowed to buy and sell on their own behalf or to participate in the business in any other way; they could only facilitate trades between other buyers and sellers. Their fees came out of the price paid in the transaction, and only after the proposed sale was approved by the merchants and the transaction was completed. The basis for calculating this fee varied. The most common was a fixed fee per unit traded, for example a fixed fee per barrel of wine, which we code as *unit_fees*. Also common were fees which depended on the price paid. These were most commonly a simple percentage of the transaction price, but were sometimes nonlinear or step functions. We code all of these as *value_fees*. When brokers were prohibited from conducting private business, we code this regulation as *private_business_constraint*. Table 2 shows the appearance of each of these rules in the regulations.

Although the observed sources are somewhat fragmentary, we can still document not only individual regulations, but also combinations of regulations that often appeared together. Many towns implemented a dominant design where they only gave a

[9] In some early sources it can be documented that brokers had to share this privilege with innkeepers, for example in Brugges (Gilliodts 1881); but there is no such general pattern recognizable in the sources investigated.

[10] For example, during the fairs in Frankfurt (Schubert 1962)

few licensed brokers the matchmaking right; these brokers did not have a right to conduct private transactions; merchants were free to use the matching service or transact on their own without a broker; and brokers were compensated with predetermined fixed fees, either unit fees or value fees as discussed above. We code these combinations of regulations as *matchmaking_with_unit_fees* and *matchmaking_with_value_fees*, respectively.

In a smaller number of towns, brokers were not prohibited from conducting private business on their own behalf, but the other regulations were the same – brokerage was limited to a small number of licensed brokers, merchants could choose whether to use a broker, and brokers received fixed unit or value fees. We code this combination of rules as *matchmaking_without_private_business_constraint*. While this combination of rules has a flavor of intermediaries who act as market makers (i.e., brokers would have acted as re-sellers on a permanent basis), no such activity can explicitly be documented from the sources.

In another, less common combination of rules, merchants were required to use a matchmaking broker, while the other regulations (only licensed brokers, no private business, and fixed unit or value fees) remained the same; we code these as *forced_matchmaking*. Even less common were regulations which did not specify a fixed level of fees (*matchmaking_without_fixed_fees*), or regulations in which we could not document that brokers had to be licensed (*matchmaking_without_licensing*), but where the other dominant rules remained the same.

For 470 observations, representing 42 towns, we observed one of these six combinations of regulations; Figure 3 shows the number of times each combination was observed. (The most common sets of rules were *matchmaking_with_unit_fees* and *matchmaking_with_value_fees*, which account for 44% and 23%, respectively, of these 470 observations.)

3.3 Policy Goals

What motivated the towns to regulate intermediation? Many towns explained their intentions with short policy statements. Most of these policy statements were based around one of five broad goals:

- To promote and facilitate trade

- To reduce damage in trade for the merchants
- To benefit the town
- To benefit the citizens
- To ensure equal treatment of all merchants (locals and foreigners, rich and poor) by brokers

None of these explanations came with more detailed elaboration. Table 2 shows how many times each of these explanations appeared in the regulations we found. (We code these five arguments as *promote_facilitate_ trade*, *create_ order_ reduce_ damage*, *utility_ citizens*, *utility_ town*, and *equal_ treatment*.) To fulfill these purposes, towns most often implemented brokerage as a matchmaking clearinghouse which merchants were free (but not required) to use, and for which they had to pay a predetermined unit or per value fee only for a successful match.

For each set of regulations, we can ask the questions: How do these regulations influence the brokers to match buyers and sellers? Do the brokers have an incentive to create welfare-efficient matches? How do the sellers and buyers behave, given the brokerage mechanism in place? Do they have an incentive to participate in the centralized matching mechanism; will they act strategically; and finally, will this influence the outcome of the mechanism in form of welfare generation and surplus division? Given that, are the policy goals stated above better served by one or another set of regulations; and if so, does this help to explain the regulations chosen in each city? To answer these questions, we set up a two-sided matching model in the next section.

4 Matching Model

Next, we introduce a simple strategic model to study the incentives related to brokerage, and their effect on outcomes in the market. We define a stable match, that is, a set of recommended trades such that no buyer and seller would prefer to go against the broker's advice and trade with each other instead. Given a fixed set of preferences for both buyers and sellers, the set of trades which take place in a stable match are (generically) unique, but the prices at which these trades occur are not uniquely determined. The way that the broker's compensation is determined may create an incentive for him to set prices which are more favorable to either buyers or sellers. The more favorable the broker is perceived to be toward sellers, the less incentive there is for sellers to strategically misrepresent their preferences (the lowest price at which they would be willing to sell). We show that overall surplus created by trade is greater when the broker's incentives make him favor sellers, and that this effect is greatest when the variation in buyer preferences is large.

4.1 The Game

Players

There is a set of buyers $B = \{b_1, b_2, \ldots, b_n\}$; each buyer b_i has a demand for a quantity $q_i > 0$ of some good. (We base this on the historical observation that most buyers in these wholesale markets were craftsmen or retailers, and were not allowed to resell the goods on the same market again. Therefore they only bought as much as they could expect to transform into other valuable goods, or sell as retailers in the upcoming period until they could buy new goods.)

There is a set of sellers $S = \{s_1, s_2, \ldots, s_m\}$; each seller s_j has a sufficient supply of one type of good. (We abstract from the scenario where goods are in scarce supply. While such cases doubtless existed, we believe that this was not the general situation. In Appendix II we argue that with scarce goods, the results would still be similar to the ones we present here.)

There is one broker, whose job is to facilitate trades.[11] We assume that the broker responds to incentives, but that his payment is small relative to the size of the trades.[12]

[11] As we discussed earlier, brokers in each city were typically limited in number and often required to work together, so for simplicity we model them as a single entity.

[12] In fact, we are assuming that the broker's incentives determine the match that is chosen in the second stage of the game (explained below), but that the broker's compensation is small enough to not effect the payoff of either the buyer or the seller. Historically, this argument can be supported by Gelderbloom (2009), pp. 140f., who concludes that the fees were rather small compared to the selling price.

Information

Before the game starts, the broker is assumed to already know the buyers' preferences.[13] As discussed above, brokers normally came from the local demand side; for example, a wine broker would likely have spent several years working as a local wine trader or as a host, and could reasonably be expected to know the tastes of the local buyers.

The sellers know the number of buyers and the quantity that each one demands, but do not know the preferences of each buyer, only the ex-ante distribution from which they are drawn. The sellers also know the quality of their own and the other sellers' goods. (This is based on the fact that merchants with similar goods often came from the same area and traveled together in caravans. We could alternatively imagine that sellers could only build expectations about the quality of other sellers, but we do not model this here.[14])

Actions

In Stage I, the sellers each (simultaneously) report a reservation price p_j to the broker. In Stage II, the broker then matches buyers and sellers, and selects a quantity q and price p at which each trade will occur. (Upon entering a town, sellers historically would go first to the brokers, who inspected the quality of their goods and suggested prices, which the buyers and sellers were free to accept or reject.)

Payoffs

Buyer b_i gets a payoff of $v_{i,j}$ for each unit of the good which he buys from seller s_j, up to his required quantity q_i, minus the price he pays. Seller s_j values each unsold unit of his own goods at r_j. Therefore if buyer b_i buys a quantity $q \leq q_i$ from seller s_j for a price of p per unit, the buyer's payoff is

$$q\left(v_{i,j} - p\right)$$

and the seller's payoff is

$$q\left(p - r_j\right)$$

[13] We discuss uncertainty on both sides in Appendix II.

[14] For a brief discussion of this scenario see Appendix II.

A player's payoffs are additive across all of the deals he is involved in, up to each buyer's capacity q_i.

Each buyer's valuation $v_{i,j}$ for each seller's goods takes the form

$$v_{i,j} = \mu_j + \sigma\left(\epsilon_{i,j} - \epsilon_{i,0}\right)$$

where μ_j is the quality of seller j's goods; $\epsilon_{i,j}$ is an idiosyncratic random term denoting buyer i's taste for seller j's goods; $\epsilon_{i,0}$ is an idiosyncratic term denoting player i's outside option (or how badly he needs to fill his capacity); and σ is a parameter controlling how variable personal tastes are. (When σ is small, buyer tastes are nearly perfectly correlated; when σ is large, buyer tastes are very variable.) μ_j and σ are assumed to be common knowledge; the only private information is the realization of $\epsilon_{i,j}$ for a particular buyer.

We make the technical assumption that $\epsilon_{i,0}$ and $\epsilon_{i,j}$ are all independent random variables drawn from a particular distribution.[15]

4.2 Stage II Outcomes

Stable Outcomes

We define a *match* as a pairing of buyers and sellers, with a price and quantity attached to each pair. Formally, define a match as a function

$$M : B \times S \to \Re^+ \times \Re^+$$

where $M(b_i, s_j)$ is the price and quantity of seller s_j's goods to be purchased by buyer b_i, which we denote $p_{i,j}$ and $q_{i,j}$.

A match is *individually rational* if

- No buyer or seller regrets any deal he is a part of: for every buyer b_i and seller s_j, if $q_{i,j} \neq 0$ then $r_j \leq p_{i,j} \leq v_{i,j}$
- No buyer exceeds his capacity: for every buyer b_i, $\sum_{s_j \in S} q_{i,j} \leq q_i$

[15] The distribution is a standard type-I extreme value, or Gumbel distribution. It has a shape similar to a normal distribution, but is such that calculations are much easier. This is the error structure which underlies the logit model – see, for example, Anderson, de Palma, and Thisse 1992.

(Note that a buyer would not be hurt by exceeding his capacity if some of the goods were free; we can rule out this possibility by assuming that the seller valuations r_j are strictly positive.)

A match is *stable* if it is individually rational and, in addition, there is no buyer-seller pair who could both be made strictly better off by trading (or trading more) with each other. Formally, an individually rational match M is stable if:

- For every buyer b_i with $\sum_{s_j \in S} q_{i,j} < q_i$ and every seller s_j, $v_{i,j} \leq r_j$
- For every buyer b_i with $\sum_{s_j \in S} q_{i,j} = q_i$, every seller s_j with $q_{i,j} > 0$, and every other seller $s_{j'}$, $v_{i,j'} - r_{j'} \leq v_{i,j} - p_{i,j}$

(The first condition rules out profitable additional trades for a buyer who is not filling his capacity; the second rules out profitable deviations for a buyer who is filling his capacity.)

Since the broker does not know seller preferences and must ask for them, we will refer below to matches which are stable with respect to the *reported* preferences, that is, where the r_j terms are the values which the sellers report, not necessarily the true values.

Fix the buyer preferences $(v_{i,j})$ and the reported seller preferences (p_j). Define

$$s^1(b_i) = \arg\max_{s_j \in S} (v_{i,j} - p_j)$$

as the seller who appears to be buyer b_i's "best match", that is, the seller who creates the largest surplus (per unit traded) by selling to buyer b_i. Let

$$\pi_i^1 = \max_{s_j \in S} (v_{i,j} - p_j)$$

be the surplus created (per unit) when b_i buys from seller $s^1(b_i)$, and

$$\pi_i^2 = \max_{s_j \in S - s^1(b_i)} (v_{i,j} - p_j)$$

the surplus created when b_i buys from his second-best match. (In the event that $s^1(b_i)$ is not a singleton, $\pi_i^2 = \pi_i^1$. Note that either π_i^1 or π_i^2 could be negative, indicating that that buyer could never profitably trade with that seller.)

Theorem 1 *Consider the generic situation where for every buyer b_i, $\pi_i^1 > \pi_i^2$ and $\pi_i^1 \neq 0$. Then a set of trades is a stable match if and only if for every buyer b_i,*

- *If $\pi_i^1 < 0$, b_i does not buy anything*
- *If $\pi_i^1 > 0$, b_i buys his full capacity q_i from seller $s_j = s^1(b_i)$ at some price*

$$p \in \left[p_j,\ p_j + \pi_i^1 - \max\{0, \pi_i^2\}\right]$$

Since $v_{i,j}$ are determined randomly and are not known to sellers when the prices p_j are chosen, this "generic" outcome will occur with probability 1. What happens when $v_i^1 = v_i^2$, or when $v_i^1 = 0$, will therefore not affect expected payoffs or equilibrium play in general.

(Note again that we ignore the broker's commission, which we assume is small enough that it does not affect the set of trades which occur.)

Now that we have characterized the stable outcomes, we can consider the incentives facing the brokers, who are paid by the successful match-making.

As noted above, the most common scheme is for brokers to receive a "unit fee," a fixed commission for each unit of goods whose sale he facilitates. A corollary of Theorem 1 is that the broker makes the same commission at every stable match:

Corollary 1 *Generically, a broker being paid unit fees is indifferent among all of the stable matches.*

This is because, when $0 \neq \pi_i^1 > \pi_i^2$, buyer b_i buys the same quantity of goods (0 if $\pi_i^1 < 0$, and q_i if $\pi_i^1 > 0$) at every stable match; if the broker's fee depends only on quantities, then it is the same at every stable match.

For a given set of buyer preferences and seller reports, the set of possible stable matches corresponds to the rectangle

$$\prod_{i\,:\,\pi_i^1 > 0} \left[p_{s^1(b_i)},\ \ p_{s^1(b_i)} + \pi_i^1 - \max\{0, \pi_i^2\}\right]$$

Under unit fees, the broker's "favorite" stable match responds to incentives in a very coarse way: we have shown that a broker receiving unit fees is indifferent among all of the stable matches. A broker receiving percentage fees, on the other hand, strictly prefers the highest-price match. This is also true if he receives a non-linear percentage fee. As for fees which are an increasing step function of the price paid, which we occasionally observe in the statutes, the broker always prefers to sell to the next higher price level, where he receives a higher fee. However, once the per-unit fee is already at its maximum, or cannot be increased further without the price exceeding the upper bound $p_{s^1(b_i)} + \pi_i^1 - \max\{0, \pi_i^2\}$, then the broker is indifferent among all stable matches at that fee level. And of course, a broker who can do private business has an incentive to buy as cheaply as possible from the seller (as close as possible to his reported reservation price), and to sell at as high a price as possible to the buyer, keeping as much surplus as possible for himself.

Broker's Incentive When Unconstrained By Stability

It is a natural assumption that the broker tries to maximize his commission by selecting among the stable matches, since buyers and sellers were generally free to ignore the broker's recommendations and find their own deals. This would harm the broker, as customers who declined the suggested match did not have to pay the broker's fee. Even if the merchants accepted the deal, but learned later that the match could have been better, they would be more likely to choose a different broker, search on their own, or avoid the town entirely in the future.

However, we should still discuss what would happen if the broker were not constrained to choose a stable match, and could select any individually rational match to maximize his commissions. There are two reasons to rationalize such a case. First, in a few particular markets for specific goods, the broker had a monopoly on the right to match buyers and sellers. And second, the persistence of the brokerage institution when its use was optional suggest that the broker had some comparative advantage in matching buyers to sellers, and we might therefore think he could abuse his position to some degree without punishment.

For brokers who are not constrained to choose a stable match, we first consider incentives under a unit fee. The broker does not increase his commission by pairing a buyer with a seller different from his "best" match, since the buyer is already buying his full capacity at any stable match. His only reason to move away from a stable match, then, would be as follows. If a buyer were priced out of the market ($v_{i,j} < p_j$

for every seller s_j), but the broker believed that the sellers had over-reported their valuations ($p_j > r_j$), he has an incentive to bargain on behalf of that buyer, to try to get a seller to sell below his asking price. Each incremental deal like this would increase the payoff to both buyer and seller (otherwise they would refuse the deal), so if we assume that the broker would only deviate from a stable match to facilitate new deals like this, the match we obtain is actually *higher* in overall welfare than the stable matches. (The possibility of such bargaining, however, might effect the seller's incentive to overreport his reservation value in Stage I.)

However, in a more general model of buyer preferences where, say, two small items could substitute for a single larger one, unit fees would give the broker an incentive to distort matches in favor of trades involving larger numbers of "smaller" goods, even when these trades were less valuable overall. However, the way the current model was specified, with each buyer having a "capacity" for a certain number of goods, this sort of deviation away from a stable outcome is not possible. Within our model, there is no way for a broker earning unit fees to increase his income by deviating from a stable outcome while respecting the sellers' reported types as truthfully given; he could only gain by convincing a seller to lower his demanded price in order to facilitate a trade that would otherwise have been impossible.

Second, we can consider the incentives of a broker getting a percentage fee (either linear or nonlinear), that is, a broker whose per-unit commission is increasing in the price at which each sale occurs. In this case, the broker has another reason to move away from the stable match pairing: his incentive is to pair each buyer with the seller whose goods he values the most, even if that seller is higher-cost and so the joint surplus from buying from this seller is not the highest. That is, if $v_{i,j} - p_j > v_{i,j'} - p_{j'}$ but $v_{i,j} < v_{i,j'}$, the broker has an incentive to pair buyer b_i with the higher-quality but more expensive seller $s_{j'}$, even though more surplus is created when he buys the cheaper good from seller s_j. In this setting, the broker would be constrained either by each buyer's individual rationality constraint, or by some notion of "how far" the broker could push buyers toward expensive items without causing them to go out on their own looking for deals. When the variation across sellers in how they value their goods is low, this result will be nearly the same as the efficient outcome. However, when the sellers' reservation values for their own goods vary greatly – and even moreso when it is correlated with how buyers value the different goods, but with a higher variance – this unconstrained outcome can deviate significantly from the stable (efficient) outcome.

Of course, the deviations discussed in the former paragraph – negotiating a lower price for buyers priced out of the market – would still be a possibility, so a broker receiving a percentage fee could deviate from a stable match in a way that could either raise *or* lower overall surplus. We would expect, however, that the latter distortions – from buyers purchasing from the "wrong" seller – will often be the stronger welfare effect, since incremental sales of the first type increase welfare only slightly.

4.3 Equilibrium of the Stage II Game

The valuations the sellers choose to report in Stage I will depend on which stable match they expect to be selected in Stage II. As we pointed out before, for a given set of buyer preferences and seller reports, the set of stable matches corresponds to the rectangle of possible prices $\prod_{i\,:\,\pi_i^1>0}\left[p_{s^1(b_i)},\ \ p_{s^1(b_i)}+\pi_i^1-\max\{0,\pi_i^2\}\right]$. Further, a broker receiving unit fees is indifferent among all stable matches, while a broker receiving percentage fees strictly prefers the highest-price match.

We can imagine a more complicated model, however, in which the broker faces a more subtle trade-off when choosing prices. If prices are too high or perceived as unfair, he might damage his reputation or risk losing his job. Since he often comes from the town, he might have a natural preference to favor local buyers over outside sellers, subject to giving the sellers sufficient profits to keep returning.

Therefore, we abstract away from the broker's exact problem, and exact response to his fee structure, by introducing a parameter $\alpha \in [0,1]$, which we interpret as the broker's taste for high transaction prices. We will let α indicate where in the interval $\left[p_{s^1(b_i)},\ p_{s^1(b_i)}+\pi_i^1-\max\{0,\pi_i^2\}\right]$ the broker sets the price: specifically, we will suppose that the broker selects the stable match where each buyer b_i buys from seller $s^1(b_i)$ at the price

$$p = p_{s^1(b_i)} + \alpha\left(\pi_i^1 - \max(0,\pi_i^2)\right)$$

Thus, $\alpha \in [0,1]$ represents the broker's relative allegiance to the sellers over to the buyers. $\alpha = \frac{1}{2}$ represents the midpoint of the possible price range, $\alpha = 0$ represents the buyer-optimal match (given reported preferences) and $\alpha = 1$ is the seller-optimal match.[16] We will assume that α, characterizing the match that will occur in Stage II, is common knowledge among the sellers. (In fact, what matters is what the sellers think will happen in Stage II when they report their reserve prices; but in a rational-expectations setup, this must be what will actually happen.) Thus, α really indicates the sellers' beliefs about how the broker will set prices once they report their valuations. This way the merchant builds his beliefs based on his knowledge or expectation of the brokerage design of the town he visits.

As mentioned above, we assume that each seller knows the quality of his and the other sellers' goods, and the distribution from which buyers' preferences are drawn.

4.4 Equilibrium of the Stage I Game

Since the buyers are identical ex-ante except for their capacities, the sellers (being risk-neutral) behave just as if they were maximizing expected profits from a single buyer, with demand $q_1 + q_2 + \ldots + q_n$. The level of this demand does not matter either, so for our calculations, we normalize it to 1. We let Q_j denote the expected fraction of the market which seller j will sell to, as a function of his own and the other buyers' reported valuations. The sellers' payoff functions are a little tricky to write, because they depend on the expectation of π_i^2 (a buyer's next-best match) when seller j is the buyer's best match; we can write them as

$$u_j = Q_j \times \left(p_j + \alpha E(\pi_i^1 - \max(0, \pi_i^2) | s_j = s^1(b_i), \pi_i^1 > 0) - r_j\right)$$

The distribution of the ϵ terms was chosen so that there would be a usable closed-form expression, which leads us to the following results. (The remaining claims in this section are proven in the Appendix.)

Theorem 2 *Suppose that in the Stage II game, the match chosen will be the one characterized by the parameter α, which is common knowledge among the sellers. Then the Stage I game has a unique equilibrium, where the valuations announced by*

[16]Since expected payoffs for a given preference structure are linear in α, we can also interpret α as an expected value. That is, assuming that the broker selected randomly among all possible stable matches with equal probability, would correspond to choosing the stable match above with $\alpha = \frac{1}{2}$. Assuming that the broker chose randomly but favored higher prices, would correspond to some $\alpha > \frac{1}{2}$, and so on.

the sellers are the unique solution to the simultaneous equations

$$(p_j - r_j)(1 - Q_j) = \sigma(1 - \alpha)$$

Further, fixing the μ_j (the average valuation for each seller's goods), each seller's demanded price p_j is increasing in σ and decreasing in α.

In fact, we can see that when $\alpha = 1$ (the seller-optimal match is chosen in Stage II), the sellers report their true valuations, $p_j = r_j$; but when $\alpha < 1$, they overreport by setting $p_j = r_j + \frac{\sigma(1-\alpha)}{1-Q_j} > r_j$. Also note that when σ is small (buyer valuations are very predictable), sellers report closer to the truth, but when σ is large (buyer valuations are very variable), sellers demand higher prices.

Theorem 3 *Overall welfare (buyer plus seller surplus) is increasing in α.*

For any given σ, overall surplus is highest when $\alpha = 1$, and strictly increasing in α over the whole range. However, the payoffs to the buyers are generally decreasing in α, with the extra benefit going to the sellers. So if $\alpha = 0$, the lowest aggregate welfare is achieved, but the broker extracts the most surplus for the buyers.

Theorem 4 *Fixing $\frac{\mu_j - r_j}{\sigma}$ (the fraction of buyers who could potentially trade with a particular seller), the effect of α on overall surplus is increasing in σ; that is, overall surplus increases more dramatically in α when σ is larger.*

Thus, total welfare is more sensitive to α (and therefore to the broker's incentives) for goods where individual tastes vary widely. For goods whose values are more uniform across all buyers, then, these is little welfare loss to setting α lower (using the buyer-optimal match, or the midpoint), as the sellers will still report close to truthfully. (We believe that this result will still generally persist when σ is changed without adjusting μ_j or r_j to keep $\frac{\mu_j - r_j}{\sigma}$ constant, but have been unable to prove it; and Theorem 4 seems like the more relevant comparison anyway.)

5 Empirics and Discussion

5.1 Variables

The theoretical model gives some insight into the welfare and policy implications of the dominant design in use. Brokerage rules, as implemented in the sources we examine, lead to close to efficient allocations. A central matchmaking clearinghouse with per value fees is attractive to a foreign seller (α=1), because it leads to the match in which he receives the maximal amount of profit. In this case he has no incentive to misreport his preferences, since he knows that the broker cannot take any of the surplus for himself and has an incentive to propose the seller-optimal match. This creates welfare-efficient matches, since the foreign seller reports truthfully and the broker already knows the preferences of the local demand side. Even the seller-friendly design gives some surplus to each buyer (due to competition among sellers); and buyers may end up better off if a seller-friendly mechanism draws more sellers to their city.

When unit fees are used, the broker can choose buyer-friendlier matches and thus split up the surplus in some other way ($\alpha < 1$), for instance equally ($\alpha = \frac{1}{2}$) or by giving the maximal surplus to buyers ($\alpha = 0$); however, this potential gain for the demand side increases the strategic behavior of the sellers, increasing the likelihood of mismatches. The magnitude of the distortion caused by such strategic behavior depends on the heterogeneity of tastes of the buyers for each specific good.

Next, we test empirically if the different implementations of brokerage rules can be explained based on the products being traded, the stated policy goals of the town and several control variables. We control for time effects, population effects in terms of city size, and geographical effects.

We take the brokerage rules used as the dependent variable, focusing on the two dominant designs. We run six types of regressions. In the first, the dependent variable is 1 if the regulations found are those described earlier as either *matchmaking_with_unit_fees* or *matchmaking_with_value_fees* – that is, if intermediation is limited to licensed brokers, merchants are free to use them or find their own deals, brokers are prohibited from doing business for themselves, and brokers are paid either fixed unit fees or fixed value fees – and 0 otherwise. The 0 stands for any other rule or combination of rules found in the evaluated source. We call this dependent variable *matchmaking.* The creation of the variable matchmaking allows us to explore when and where matchmaking designs in the form of a central clearing-house were implemented in the first place, before we study the design at a more differentiated level. In the second regression, we explicitly consider the choice between these two particular sets of regulations, by excluding observations which are not one of these; the dependent variable is 1 if a set of regulations contains all the elements of *matchmaking_with_unit_fees*, 0 if it contains all the elements of *matchmaking_with_value_fees*, and the observation is excluded if it is neither. In the third regression, the dependent variable is 1 if the regulations include only the set of rules *matchmaking_with_unit_fees* and 0 otherwise, with all observations included**.** In the fourth regression the dependent variable is 1 if the regulations include only the *matchmaking_with_value_fees* and 0 otherwise. Finally, we look into the two most interesting single regulations from an economic point of view: the private business constraint *pb_constraint* and the choice of the brokerage fee. In the fifth regression dependent variable becomes 1 if we observe the variable *pb_constraint* and 0 otherwise. In the sixth regression the dependent variable becomes 1 if a unit fee is used and 0 if a value fees is applied.

Our main dependent variable are the different product genres and the policy goals identified in the regulations.[17] Different product genres had different levels of heterogeneity, both across different sellers' products and in terms of individual buyers' tastes. Thus, we could expect the degree of asymmetric information to vary across different types of goods. In addition, some product markets were better-integrated and more competitive than others. Thus, we can expect that different product genres might be more or less favorable toward different brokerage designs; and different policy goals might be better served by different brokerage designs as well.

The control variables are the following ones: We control for three different time effects. First, we control for a simple time trend by including the year as an explanatory variable; we label this variable *period.* Secondly we check for learning effects. We control for learning, by including the length of time between the first implementation of a brokerage regulation in a specific town and the observation in question; we call

[17] To check for robustness of the results we run the same type of regressions but limit the number of binary explanatory variables by grouping together some of the products. We create the group *foodstuff*, which includes *wine_beer*, *grain*, *fish*, *cattle_meat*, and *oil_fat*, and similarly create the group *textile_products*, which includes *raw_textile*, *fur_leather_skin*, and *cloth.* The main results do not change.

this variable *time*. Third, we weight the variable *time* with the variable *period*. We divide the variable time by the square of the variable period. We call this variable *time_perw.* This means for example we give the learning time of a city during the 13th century more weight than during the 15th century. This way we can check if the implementation time for a matching design changed over time.

We also control for five different geographical effects. First, we include the distance of a town from the sea, using the variable *logdist_sea*.[18] We include the physical location of each town, measured as the distance west to the westernmost city (Ypres) via the variable *logdist_west*, and the distance north to the second northernmost city (Danzig) via the variable *logdist_north*. [19] We measure the distance from each city to the cities of the Lower Countries, Brugge (for the time 1250-1500), Antwerp (1500-1585), and Amsterdam (1585-1699), via the variable *logdist_nl*. These cities indicate the epicenter of trade north of the Alps during the period of investigation. Finally, we control for externality effects of neighboring cities. We measure the distance between each city and the three closest neighboring cities which also have brokerage regulations at the time of the observation. We call this variable *logdist_nextc*. This allows us to analyze if there is a neighboring externality effect due to closeness. Finally, we control for the population of each city with the variable *logpop*.[20] The reason for each of these controls is discussed below.

For all regressions, we use binary logit models, and cluster the observations from the same town. This way we take into account correlation of error terms within the same city due to unobserved cluster effects (Wooldridge 2002, chapter 15).

5.2 Predictions and Results

Goods

Town officials had various reasons for implementing centralized market-clearing mechanisms. First, a precondition for the need of such a mechanism is a sufficient information asymmetry between the demand and supply side. We can expect this in particular for goods with heterogeneous tastes; for the simplest and most homogeneous goods,

[18] We take the logarithm of all geographic and population variables.

[19] The most northern city Nowgorod is a geographical extreme outlier and is not appropriate to be used as a geographical corner for the estimation. Nowgorod as well as Danzig and Ypres become 0 on the log scale.

[20] We use the Bairoch (1988) data for this control variable.

we might expect no matchmaking mechanism at all to be required. Secondly, the town officials might have an interest in serving particular needs of its citizens: for example, to guarantee a sufficient supply of foodstuffs for the local population.(Hibbert 1965, pp. 161ff.) Thus we might expect the implementation of matchmaking designs for basic foodstuff as wine, beer, grain, fish and similar product genres. Another interest was to support the growth of local industry.(ibidem, pp.172ff.) The textile industry can be recognized as the most important production and export sector for many cities of the sample (Munro 1994, 1995); thus, we might expect the implementation of matchmaking designs for raw input factors as the product genres *raw_textile*, *fur_skin_leather* or semi-finished *cloth*. This way the matching mechanism improves the matching quality, which supports the local industry and also makes the town more attractive for foreign sellers. Another candidate for implementing central matching mechanisms could be the product genre finance. In a period of city growth based on trade we could expect a strong need for financial institutions and clearing mechanisms.

Based on the theoretical model, we expect to find seller-friendly rules for products with highly heterogeneous tastes, since the welfare gains to more seller-friendly prices are greater; we also expect more seller-friendly rules when there is stronger competition between towns to attract sellers. Conversely, we expect buyer-friendlier rules (or no matchmaking design at all) for more homogeneous goods, settings with more relaxed competition, and settings where there was a specific need to give more surplus to the local demand side.

Among the categories of goods being traded in the towns we study, most basic foodstuffs were rather homogeneous, and we can expect buyer valuations to have been predictable; grain, fish, meat, oil and fat belong to this category. Wine and beer also fit into this group. (Only a small fraction of the wine consumed was high quality wine, where we might expect more variable valuations (Kellenbenz 1986).) For spices, we can expect relatively heterogeneous valuations, due to the variety of tastes and the long lists of different goods found in regulations. Horses would also be associated with more heterogeneous preferences, since each horse is different and buyers might have different uses for horses.

Cloth definitely belongs to the goods related to heterogeneous preferences of buyers. The textile industry during the period of investigation was extremely creative and innovative in designing various types of cloth (and clothing) for an increasingly sophisticated demand side (Munro 1995). In contrast, input goods such as raw textiles (wool, linen, silk, etc.) are more homogeneous, and the requirements of the processing industry more predictable. This might be somewhat different for the category *fur_skin_leather*, since these products are by nature more heterogeneous. The valuations for metals and construction material can be expected to be rather predictable. In contrast the preferences for property in the form of houses and land can be expected to be very variable. Finally, preferences for financial products, in particular bills of exchange, must be rather heterogeneous, since preferences depended very much on the participants of the bill and the place where the bill was drawn on. The limited tradability of bills of exchange made the valuation even more heterogeneous(van der Wee 1963, North 1981, Munro 1994).

With respect to competition, we can expect a lower level of market integration, and thus more relaxed competition, for bulky goods with less value per weight. Most of the consumption goods fit this description; metals and construction material can be included. In contrast, the textile market has been recognized as one of the best integrated commodity markets of the time (also with a higher value per weight and thus relatively lower transportation costs) and highly competitive (Munro 2003, van der Wee 2003). In addition, since many merchant cities built their own textile industry, there was a big demand for input goods such as raw textile, fur skin, leather or semi-finished cloth. (Werveke 1965, pp. 354-6; Parry 1967, pp. 173-215, Kellenbenz 1986, pp. 209-212, 214, Munro 1998, 2003) Hence, we can expect towns to have implemented more seller-friendly mechanisms to support the local textile industry. Horses also belong to the category of goods which are easy transportable, and thus we can expect strong competition between different towns. This is not true for property due to the immobility of the good. Finally, the market for financial instruments must have been at least during the early period of our investigation rather restricted (but with potential for stronger market integration and competition as time passed).

Table 4 shows the number of observations of each product associated with the two dominant combinations of regulations, *matchmaking_with_unit_fees* and *matchmaking_with_value_fees*. As predicted, the various foodstuffs were associated much more often with unit fees, as were metal and construction materials. Horses were associated exclusively with value fees, as was property; financial products were associated mostly with value fees as well. The other product genres were associated with a mix of unit and value fees.

Table 5 shows in full detail the output of the six types of regressions. Column 1 depicts the results of the binary choice between the matchmaking design and everything else. Column 2 shows the binary choice between the buyer-friendlier and the seller-friendly design. Column 3 shows the results for the choice between the buyer-friendlier design and everything else. Column 4 reports the analogue results for the seller-friendly design. Finally columns 5 and 6 depict the results for the private business constraint and the choice between the unit and value fee.

Let us first have a look at the empirical results for the basic foodstuff: *wine_ beer, fish, grain, cattle_ meat,* and *oil_fat.* For the product genres wine_beer we find positive significant results for the dependent variable *matchmaking* in column 1. In the direct comparison between both designs, all goods are positively significant. Thus the product genres can be assigned to the buyer-friendlier design. This result is confirmed by the positive sign in the regression in column 3 (*matchmaking with unit fees*) and the negative signs in column 4 (*matchmaking with value fees*). These results are in line with the descriptive statistics (table 4), where we can assign all these products to buyer-friendlier designs. In addition, when we look into the individual regulations we can relate all these goods to unit fees. The results in the regression in column 6 are all positively significant. For the dependent variable private business constraint (*pb_ constraint*) in column 5 we find positive significant coefficients for the product genres *wine_ beer* and *grain.* The estimator for *wine_ beer* confirms the results for the significant results for the matchmaking design in the regression in column 1. The coefficient for the grain market cannot be confirmed in the general matchmaking design.

These results confirm the predictions that the product group foodstuff is generally associated with the buyer-friendlier designs when brokers are used. Foodstuffs were rather homogeneous, hence the space for strategic behavior of merchants was rather limited. This way we can rationalize the choice for buyer-friendlier mechanisms, which permitted the broker to give some surplus to the buyer side. In addition, since these goods were ready to consume, only limited added-value could be generated. Thus, it was important for local retailers who bought the goods to profit from the trade margin. The assumption that matchmaking mechanisms were implemented to guarantee basic food supply gets support only for the product genre *wine_ beer* and partly for grain in the form of the private business constraint; the homogeneity of these goods probably made the brokerage mechanism dispensable overall.

For spices we find a positive significant coefficient for the matchmaking design in column 1. This can be confirmed by the positive significant coefficient for the private business constraint in column 5. A clear seller-friendly or buyer-friendlier design cannot be identified based on the other regressions. Thus for spices, the implementation of some matchmaking design was more likely; this can be explained due to the strong information asymmetry between buyers and sellers due to the long-distance-trade nature of these goods. However the empirical output does not deliver any clear assignment to the expected seller-friendly design. One explanation for this could be the sometimes very long and detailed lists of spices found in the sources, each with their own unit fees; by dividing up the market this finely, heterogeneity could potentially be reduced.

Another group of products are related to the clothing industry: *cloth*, *raw_ textile*, and *fur_ skin_ leather*. The regression with the dependent variable matchmaking delivers positive significant coefficients for the variables *raw_ textile* and *fur_ skin_ leather* in column 1. The estimator for *cloth* is just outside the 10% significance level. Also, all estimators for the private business constraint (*pb_ constraint*) in column 5 are significantly positive. In the comparison of the two different designs (see the results in columns 2-4), cloth can be assigned to the seller-friendly design, *raw_ textile* can be weakly assigned to the seller-friendly design, and finally *fur_ skin_ leather* cannot be related to any of the two designs. These results confirm the assumption that towns implemented matchmaking regulations to improve the matching between the foreign sellers of input goods and the local textile industry. The relatively frequent use of seller-friendly designs for these product genres confirms the two arguments outlined in a previous section. First, during the period of investigation the textile industry was one of the best integrated markets for commodity goods. Second, most towns were producing their own textile products. There was thus a need for the town to obtain raw textile or semi-finished cloth for their textile processing industry. Both arguments increase the competition for textile and cloth products between cities. In addition, since the local textile industry was creating a substantial added value (Munro 1998, p. 55), local buyers were willing to sacrifice some of the surplus generated by trade rather than risk an inefficient matching or not receive the products at all. Finally, the heterogeneity of the cloth products would have intensified the strategic behavior of the merchants.

The variable *metals* does not deliver any significant result. This confirms the expectation that there was in general less need for a clearing mechanism for homogenous and bulky goods. Also for *construction* we do not find any significant result for the implementation of any matchmaking design. However the coefficient for the private business constraint in column 5 is positively significant. In the direct comparison construction materials can be assigned to a buyer-friendlier design (see columns 2-4). This confirms the less likely implementation for homogenous and bulky goods with less competitive pressure and the use of buyer-friendlier designs in case town officials decide to implement any matchmaking design.

For the variable *horses* we find no significant results for the matchmaking regression in column 1, but in the direct comparison we can assign horses to the seller-friendly design. The coefficient in column 4 is positive significant and the descriptive statistics assign the variable horses exclusively to the seller-friendly designs. This confirms the predictions made. Here again, we can point to the arguments for a well-integrated market (low transportation costs) and heterogeneous tastes outlined in a previous section. Therefore the findings of seller-friendly mechanisms can be rationalized to guarantee efficient matching. However a general need for a matchmaking design for horses cannot be found.

The coefficient for *finance* is right at the 10% significance level in column 1. In comparison, finance can be assigned to the seller-friendly design (columns 2-4). This confirms the prediction that finance needs to be assigned to the seller-friendly design. Surprising is that no strong results for the implementation of a centralized clearing mechanism can be found since in a period of expansion of trade a need for financial clearing institutions could be expected. The missing matchmaking design for finance may have to do with the fact that other complementary institutions developed relatively early in the merchant cities which served these institutions, for example money changers or brokers for products made at the same time as complementary finance deals. This way it was difficult to assign brokers for finance a specific matchmaking obligation. Furthermore, it is difficult to control a broker who mediated financial products since the related physical products were missing.

Finally let us have a look at the results for *property*. Here we only find significance for value fees in column 6. The reason why we can hardly find any significant results for matchmaking institutions in form of brokerage for property was probably because land, manors and houses were bought and sold mainly among locals. Thus, we cannot expect strong information asymmetry here. The fact that we do find some amount of brokerage regulations in the investigated cities leads to the conclusion that property brokers had a different obligation in form of notary obligations than a matchmaking function.

Policy Variables

The implementation of a matchmaking design contributes to all five policy goals found in the regulations. It gives access for all merchants to (close to) efficient allocations. It increases the utility of the town and its citizens in the form of an increase in benefits based on trade. The design reduces the potential damage for merchants, especially in the minimization of the risk of being cheated by brokers who engage in private business. Finally, an efficient matchmaking design promotes and facilitates trade. However the buyer-friendlier design is more advantageous to the local citizens, since more surplus is given to the buyer. In addition, a buyer-friendlier design enables equal treatment through fair equal surplus division. On the contrary the seller friendly-design increases the aggregate welfare. Thus, town officials who want to attract foreign merchants and want to create as many efficient matches as possible may favor a seller-friendly design.[21] The other two policy goals do not clearly favor one design over the other.

The policy variables *equal_ treatment, utility_ citizens,* and *promote_facilitate_ trade* are positively significant for the dependent variable matchmaking in column 1. These results are in line with the significance of the coefficients in column 5 related to the private business constraints. In the direct comparison of the two designs in column 2 the policy variables *utility_ citizens, promote_facilitate_ trade*, and *create_ order* can be assigned to the buyer-friendlier design, the policy variable *utility_ town* can be assigned to the seller-friendly design. The policy variable *equal_ treatment* can only be weakly assigned to the buyer friendlier design. The results of the regression in column 6 related to the choice of the brokerage fee confirm these results.

These results support the general findings that the identified (close to) efficient matchmaking design, was introduced to give in particular all people equal access to the products traded, to promote and facilitate trade and finally more specifically to give the citizens access to the market. With respect to the predictions of different surplus division and welfare characteristics the empirical results confirm the theoreti-

[21] For a discussion of the different interests of the town and the trade-off between the buyer and seller side see Hibbert 1965, pp. 157ff.

cal findings that the buyer-friendlier design can give more surplus to the local buyers and thus this should be the policy choice of the local government to support the local demand side. In contrast the seller-friendly design rather fulfills the goal of maximizing total welfare; this may still be in the interest of the town, since by attracting sellers and minimizing strategic behavior, it may raise both sides' welfare. The theoretical prediction that equal treatment can be rather reached by a buyer-friendly design can only be weakly confirmed since in the direct comparison the estimator is positive (as expected) but not significant. The assignment of the policy variables to promote trade and create order to the buyer-friendlier design might be explained by the potential of a fair surplus division, since both policies can be easier achieved if both sides of the market get a fair treatment.

Time Effects

Controlling for the year allows us to recognize and sort out historical time trends. Gelderblom (2009) argues based on qualitative observations that a strong regulation of brokerage organized by the towns can be found in cities of the Lower Countries during the late Middle Ages, and starts disappearing during the early modern time. If this is a general trend for the area of investigation, we should expect a negative sign for the variable *period* in our first regression. Assuming simple learning effects within towns, we expect to find a positive coefficient for the explanatory variable *time*. If towns are able to learn over time not only from their own experience but also from neighboring cities which implemented the efficient designs already (as discussed with Leipzig in chapter 2), we should expect that the learning time shortens over time, so the coefficient on the variable *time_perw* should be negative.

The variable *period* is for all regressions except for the *matchmaking_with_value_fees* (negative but not significant) significantly negative. The variable *time* for all regressions except for the *matchmaking_with_value_fees* (positive but not significant) significantly positive. The variable *time_perw* is significantly negative for *matchmaking_with_unit_fees* in column 3 and in the direct comparison of the two designs in column 2. For the matchmaking design in general in column 1 the sign is also negative, but not significant. The coefficients for individual rules are not significant.

These results confirm the findings by Gelderbloom in the case of the matchmaking design for the general time trend. In the direct comparison the seller-friendly design was implemented later than the buyer-friendlier design. This later implementation can be explained by a general increase of competition over time and thus a stronger need for a design which gives more surplus to the seller side. An additional remark should be made about the marginal effect of implementing a matchmaking design over time. The coefficient is around -0.002; this means that with a change over time for example by 100 years, the likelihood of an implementation falls by 20%. If we put this change into the context of the full period of investigation, which is about 450 years, this effect is quite big. The positive coefficient for the variable *time* confirms the expected learning effects within a city. The negative coefficients for learning effects over the period of investigation for the different matching designs supports the argument that cities were able to shorten the learning span by imitating other cities. However this is not true for the seller-friendly design. This result is confirmed if we compare both designs then the implementation of the buyer-friendlier regulations on the city level took longer than the seller-friendly design. This can be explained by the fact that several towns which started using brokerage later in time implemented seller-friendly designs right from the beginning. Such a pattern can be documented for example for Danzig or Bremen.

Geographical Effects

Economic historians who have studied this region and time period have argued that the area in the west and north (with the exception of Southern Germany from the 15th century onwards) was economically better developed; trading technologies were more advanced and trading quantities bigger.(Postan 1987, chapter IV) This was because it was easier to ship goods between cities via the Baltic and North Sea than on land routes and along most rivers. In addition, land trading routes in the west were more established than in the east for the area of investigation. These arguments can be supported by the fact that the leading trade cities north of the Alps can be found in Brugge from the 13th until the 15th century, Antwerp from the late 15th until the late 16th and Amsterdam from the late 16th, the 17th century and beyond. Thus the area of the Lower Countries is understood as the epicenter of trade for the period of investigation. Furthermore, Bairoch (1988) and later Acemoglu et al. (2005) have found that from the 17th century onwards, access to the Atlantic Ocean was critical for economic growth. Following all these findings, we should expect that coefficients of the variables *logdist_ sea, logdist_ north, logdist_ west,* and *logdist_ nl* to all negative for the different matchmaking designs. In the direct comparison of the two designs we should expect to find rather seller-friendly designs closer to the north, west, the Lower Lands, and sea due to the stronger trade intensity and competition in these areas. Finally, implementing efficient brokerage designs can also depend on the trade and market making activities of neighboring cities. We can expect stronger learning effects the closer other cities are which also experiment with brokerage activities. In addition, the closeness also puts pressure on the cities. If one merchant city establishes brokerage, then this may increase market platform competition between cities, pressuring nearby cities to also establish market clearing institutions in the form of brokerage rules.

The coefficients of the control variable *logdist_ north* are negative and significant for the *matchmaking* design in column 1, the *matchmaking_ with_ unit_fees* in column 3 and the private participation constraint (*pb_ constraint*) in column 5. The coefficient in the regression with dependent variable *matchmaking_ with_ value_ fees* in column 4 is also negative but not significant. In the direct comparison of the two designs in column 2 and the different fee structure in column 6 the coefficients are significantly positive. The results for the distance to the west are only in the direct comparison positive and significantly negative for the explanatory variable of the private business constraint. The distance to the Lower Countries are only significantly positive in the direct comparison. The distance to the sea is significantly positive for all dependent variables except for *matchmaking_ with unit_fees* (positive, but not significant) and for the comparison of the fee structure: here we find a significant negative result. Finally the distance between cities is significantly negative for the matchmaking design and the participation constraint. In the comparison of different fees we find positive significance. This is in line with the positive sign in the direct comparison between the two different designs.

These results only partly confirm the general view about the economic development of different regions in the area of investigation. Whereas the closeness to the north can be confirmed as an impact factor of the economic development, the closeness to the west and to the Lower Countries can only be partly confirmed. We find a stronger likelihood of implementing matchmaking designs closer to the north. In the comparison we also can find rather seller-friendly designs in the north. With respect to the west and to the merchant cities of the Lower Lands we can confirm only a greater likelihood of finding seller-friendly designs. This however supports the argument of the implementation of seller-friendly designs in areas with stronger trade intensity and competition. The closeness to the sea in general does not play a role for the finding of sophisticated matchmaking designs. What we observe is that cities closer to the sea are more likely to use a matchmaking design with unit fees. This can be explained by the fact that bulky and homogenous goods were rather shipped along the coasts since bigger amounts could be carried. Thus this coefficient captures additional effects which could not be assigned to the goods differentiation explored earlier on. The negative (partly significant) coefficient for the closeness to the next city with brokerage mechanisms confirms the argument that competition between markets and learning impact the implementation of brokerage. Also the more likely use of value fees and the seller-friendly design for "closer" cities support this argument further.

Population Size

The population size could have different consequences for market design. On the one hand, we expect more trading activities in bigger towns, and thus a greater need for brokerage institutions. On the other hand, it is easier for town officials to control brokerage activities in a smaller city. Thus, brokerage regulations might be more or less likely in smaller towns; and relating the population size to one or the other design is also not clear-cut. One argument is that bigger towns will tend to implement a seller-friendly design because of greater intensity of trade and a greater need to attract more traders.

The coefficients for the matchmaking design, the design with unit and value fees are all negative but not significant. In the direct comparison the coefficient is positive, but also not significant. The negative but not significant coefficient for the matching design supports the argument that the implemented centralized clearing house mechanism worked better for smaller towns. The only significant result can be found in column 6 where population size can be assigned to value fees. However this cannot be confirmed in the comparison of the different matchmaking designs.

5.3 Further Discussion

These results confirm the conscious implementation of brokerage regulations based on different products and policy goals. Furthermore, time and geographic variables play an important role explaining the observed differentiated design. Table 6 summarizes the predictions and findings again. The question that remains to be answered is what we can learn from the implementation of these complex market designs for pre-industrial city growth. The creation of market-clearing mechanisms increases the allocation efficiency by increasing trade and, ideally, reducing the inefficiencies created by strategic behavior. This increases the incentive to create trade and thus also to invest in production for trade, which is the driving force of growth. Central to see is that the implementation of the clearing mechanism is made for everybody, not only for some privileged people. The policy statement of equal treatment documents this very well. Thus, the cities create incentives and opportunities for all of their citizens.

Crucial to mention here is that there is no need for all merchants or citizens to use this mechanism to create the benefits discussed. The clearing mechanism can also be understood as an outside option or a reasonable threat for merchants who start dealing in a bilateral bargaining situation. Both a foreign merchant and his local counterpart know that they can always go to a broker for a second opinion about the price they can demand for the quality of goods they sell.

Finally, it is important to emphasize the active role of merchant cities in introducing and developing markets, and the context in which they implemented these regulations: through market platform competition among cities. In this way the evolution of markets in pre-industrial Europe is on the one hand the result of an active creation of market mechanisms or centralized clearing houses and on the other hand driven by an abstract market mechanism in form of inter-market platform competition.

6 Conclusion

This paper studied the market microstructure of pre-industrial Europe. We examined brokerage as a market-clearing institution implemented by the town officials in late medieval and early modern merchant cities. We showed that methods of buyer- and seller-friendly rules were known and applied, and the towns developed formal institutions to deal optimally with information asymmetries and incentive constraints.

To achieve these results, we created in the first step a comprehensive source analysis covering brokerage statutes from 42 towns north of the Alps in Central and Western

Europe from the late 13th century until the end of the 17th century. We identified brokerage as a centralized matchmaking institution implemented by towns to promote and support trade, to create welfare for the town and their citizens, and to give equal opportunities to the citizens and merchants. In the second step we took the dominant design and placed it into the framework of a two-sided matching model. We showed that merchant cities implemented brokerage as a centralized matchmaking clearing house mechanism to increase aggregate welfare between the local demand and foreign supply side. This was done by creating incentives for brokers to create efficient matches (based on the reported preferences of the merchants). In addition, the regulations were implemented in such a way to minimize the strategic behavior of merchants, which could lead to mismatches and welfare loss. We showed that towns differentiated seller-friendly from buyer-friendlier matching mechanisms: in the seller-friendly mechanism, the broker had an incentive to give all the surplus to the seller; in the buyer-friendlier mechanism a broker was free to choose how he splits the surplus between the matching pair of merchants.

In a third step we tested empirically if the implemented matchmaking designs can be explained by different product categories and policy variables. We showed that the decision whether towns implemented brokerage as a matchmaking design and whether they decided to implement seller-friendly or buyer-friendlier designs depended on the products and on some of the policy goals formulated in the regulations. Furthermore we found time and geography related effects.

These results show the active role of merchant cities in pre-industrial Europe in creating markets and in solving incentive and allocation problems. The driving force of these activities can be seen in the increase of trade and in stronger market integration which created inter-market platform competition among merchant cities. These results support the argument that formal institutions are needed for further economic expansion and growth.

These results open up new questions for a future research agenda. This paper only covered one specific market clearing mechanism out of a whole set of medieval market rules. These rules covered further regulations related to market location and the timing of buying and selling goods. It would be of considerable interest to examine the interplay of brokerage and other market mechanisms in pre-industrial markets. Another question relates to the evolution and learning behavior of market rules in merchant cities. This comprehensive set of brokerage rules allows the study of the learning behavior of cities in a long-run historical context. In addition, it would be interesting to link market making activities more explicitly to city growth.

7 References

7.1 Literature

Acemoglou, Daron, Simon Johnson, and James Robinson, 2005. The Rise of Europe: Atlantic Trade, Institutional Change and Growth, *American Economic Review*, 95 (3), 546-579.

Anderson, Simon, Andre´de Palma, and Jacques-Francois Thisse, 1992. Discrete Choice Theory of Product Differentiation. Cambridge, MA: MIT Press.

Bairoch, Paul, 1988. Cities and Economic Development, from the Dawn of History to the Present, Chicago: University Press.

Bairoch, Paul, Jean Batou, and Piere Chevre, 1988. La Population des villes Europeennes, banque des donnees et analyse sommaire des resultats: 800-1850, Geneva: Droz.

Blockmans, Wim, 1996. Das Westeuropäische Messenetz im 14. und 15. Jahrhundert, in: Johanek, Peter und Heinz Stoob (eds.), *Europäische Messen und Maerktesysteme in Mittelalter und Neuzeit*, Köln: Böhlau Verlag, 37-50.

Boerner, Lars, and Albrecht Ritschl, 2009. The Economic History of Sovereignty: Communal Responsibility, the Extended Family, and the Firm, *Journal of Institutional and Theoretical Economics*, Volume 165 (1), pp. 99-112.

Bruebach, Nils, 1994. Die Reichsmessen von Frankfurt am Main, Leipzig und Braunschweig, *Beiträge zur Wirtschafts- und Sozial Geschichte 55,* Stuttgart Steiner.

Buecher, Karl (ed.), 1915. Frankfurter Amts- und Zunfturkunden bis zum Jahre 1612, Frankfurt a. M.: Baer.

Cantoni, Davide, and Noam Yuchtmann, 2009. Medieval Universities, Legal Institutions, and the Commercial Revolution, Working Paper, Harvard University.

Ehrenberg, Richard,1884. Makler, Hosteliers und Börse, vom 13. bis zum 16. Jahrhundert, *Zeitschrift für das gesamte Handelsrecht* 30, Stuttgart.

Epstein, S. R., 1998. Craft guilds, apprenticeships, and technological change in pre-industrial Europe, *Journal of Economic History*, 58, 684-713.

Frensdorff, Ferdinand, 1901. Der Makler im Hansagebiet, Göttingen.

Gelderblom, Oscar, 2009. Violence, Opportunism, and the Growth of Long-Distance Trade in the Low Countries 1250-1650, book manuscript, Utrecht University.

Gehrig, Thomas 1993, Intermediation in Search Markets, *Journal of Economics and Management Strategy* 2, 97-120.

Gény, Joseph, 1902. Elsäsische Stadtrechte, I Schlettstadter Stadtrechte, Heidelberg: Carl Winter's Universitätsbuchhandlung.

Gerteis, Klaus, 1989. Boten, Posten, Korrespondenz im Mittelalter und früher Neuzeit, in: Hans Pohl (ed.), Die Bedeutung der Kommunikation für Wirtschaft und Gesellschaft, *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte*, Beiheft 87, 19-36.

Gilliodts- van Severen, L., 1881 Les Anciens Règlements de la Corporation de Courtiers de Bruges, *La Flandre, Revue des monuments d'histoire et d'antiquitiés* XII, 121-148, 219-260.

Greif, Avner, 1993. Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition, *American Economic Review* 83 (3), 525-548.

Greif, Avner, 1994. Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies, *Journal of Political Economy* 102 (5), 912-950.

Greif, Avner, 2006.Institutions and the Path to the Modern Economy, Lessons from Medieval Trade, Cambridge: University Press.

Greif, Avner, Paul Milgrom and Barry R. Weingast, 1994. Coordination, Commitment, and Enforcement: The Case of the Merchant Guild, *Journal of Political Economy* 102 (4), 745-776.

Hibbert, A. B., 1967. The Economic Policies of Towns, in: M. M. Postan et al. (eds.), *The Cambridge Econoic History of Europe*, Volume III, pp. 157-230.

Hickson, C. R. and E. A. Thompson, 1991. A new theory of guilds and European Economic Development, *Explorations in Economic History* 28, 127- 168.

Hoehlbaum K., K. Kunze, H. G., Van Rundstedt, and W. Stein, 1876- 1939. Hanisches Urkundenbuch, 11 vol.

Houtte, J.-A. van, 1936. Les Courtiers au Moyen Age, in: *Revue Historique de Droit Francais et Etranger*, Quatrième Série, quinzième année, 105-141.

Hunt, Edwin S. and James M. Murray, 1999. A History of Business in Medieval Europe, 1200-1550, Cambridge: Cambridge University Press.

Kellenbenz, Hermann and Rolf Walter, 1986. Das Deutsche Reich 1350-1650, in: Wolfram Fischer et al. (eds.), *Handbuch der Europäischen Wirtschafts- und Sozialgeschichte*, Band 3, Stuttgart: Klett Cotta, 822-893.

Kellenbenz, Hermann, 1986. Wirtschaft und Gesellschaft Europas 1350-1650, in: Wolfram Fischer et al. (eds.), *Handbuch der Europäischen Wirtschafts- und Sozialgeschichte, Band 3*, Stuttgart: Klett Cotta, 1-388.

Kellenbenz 1990. Die Fugger in Spanien und Portugal, 3 Volumes, München Vögel.

Kuske, Bruno 1913. Die Kölner Märkte und Warenhäuser im mittelalterlichen Köln, Jahrbuch des Kölnischen Geschichtsvereins (2), 75-133.

McCusker, John J. and Cora Gravesteijn, 1991. The Beginnings of Commercial and Financial Journalism, Amsterdam: NEHA.

Levin, Jonathan, 2003. Supermodular Games, Lecture Notes, Department of Economics, Stanford.

Lopez, Robert S., 1976. The Commerical Revolution of the Middle Ages 950-1350, Cambridge: Cambridge University Press.

Moltke, Siegfried, 1937. Mäklergeschichte von Leipzig.

Munro, John 1990. Urban Regulation and Monopolistic Competition in the Textile Industries of the Late-Medieval Low Countries. in: E. Aerts. and John Munro (eds.) *Textiles of the Low Countries in European Economic History.* Leuven: Leuven University Press.

Munro, John, 1994. The International Law Merchant and the Evolution of Negotiable Credit in Late-Medieval England and the Low Countries, in: John Munro (ed.): *Textiles, Towns, and Trade: Essays in the Economic History of Late Medieval England and the Low Countries,* Ashgate: Aldershot..

Munro, John 1998. The Symbiosis of Towns and Textile: Urban Institutions and the Changing Fortunes of Cloth Manufacturing in the Low Countries and England, 1270-1570, working paper, University of Toronto.

Munro, John 2003. Medieval Woollens: The Western European Woollen Industries and Their Struggles for International Markets, C. 1000-1500, in: David Jenkins (ed.), *The Cambridge Histor of Western Textiles*, Volume 1, Cambridge: Cambridge University Press.

Neeman, Zvika, and Nir Vulkan 2005. Markets Versus Negotiations: the Predominance of Centralized Markets, working paper, Boston University.

Niederle, Muriel and Alvin E. Roth, 2003. Unraveling Reduces Mobility in a Labour Market: Gastroenterology with and without a Central Match, *Journal of*

Political Economy 111 (6), 1342-1352.

North, Douglass C. , 1981. Structure and Change in Economic History, New York: Norton.

Parry, J. H. 1967. Transport and Trade Routes, in: in: M. M. Postan et al. (eds.), *The Cambridge Economic History of Europe, Volume 4*, 155-222.

Pomeranz, Kenneth 2000. The Great Divergence, Europe, China, and the Making of the Modern World Economy, Princeton: Princeton University Press.

Postan, M. M., 1987. The Trade of Medieval Europe, in: Postan et al. (eds.). *The Cambridge Economic History of Europe*, Volume 2, Cambridge: Cambridge University Press, pp. 168-305

Reyerson, Kathryn L., 2002. The Art of the Deal, Intermediaries of Trade in Medieval Montpellier, Leiden: Brill.

Richardson, Gary, 2004, Guilds, laws, and markets for manufactured merchandise in late-medieval England, *Explorations in Economic History* 41, 1-25.

Roover, Raymond de 1965. The Organization of Trade, in: M. M. Postan et al. (eds.), The Cambridge Economic History of Europe, Volume 3, 42-118.

Roth, Alvin E. and Marilda A. Oliveira Sotomayor, 1990. Two-Sided Matching, A Study in Game-Theoretic Modeling and Analysis, Cambridge: Cambridge University Press.

Roth, Alvin E. and Uriel G. Rothblum, 1999. Truncation strategies in matching markets – in search of advice for participants, *Econometrica* 67, 21-43.

Roth, Alvin E. 2008. What have we Learned from Market Design, *Economic Journal 188 (527), 285-310.*

Roth, Johann Ferdinand, 1802. Geschichte des Nürnbergischen Handels, 4 vol., Leipzig: Adam Friedrich Böhme.

Rothmann, Michael, 1998. Die Frankfurter Messen im Mittelalter, Franz Steiner Verlag: Stuttgart.

Rust, John, and George Hall 2003, Middlemen Versus Market Makers: A Theory of Competitive Exchange, *Journal of Political Economy* 111, 353-403

Schmieder, Eberhard, 1937, Die Unterkäufer im Mittelalter, *Vierteljahrsschrift für Sozial- und Wirtschaftsgeschichte* 30.

Schneider, Jürgen 1989. Die Bedeutung von Kontoren, Faktoreien, Stützpunkten, Märkten, Messen und Börsen im Mittelalter und früher Neuzeit in: Hans Pohl (ed.), *Die Bedeutung der Kommunikation für Wirtschaft und Gesellschaft*, Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte, Beiheft 87.

Schubert, Hartmut, 1962. Unterkauf und Unterkäufer in Frankfurt am Main im Mittelalter, Diss., Frankfurt.

Spulber, Daniel (1996), Market Microstructure and Intermediation, *Journal of Economic Perspectives 10*, 135-152.

Stein, Walter (ed.), 1893-1895. Akten zur Geschichte der Verfassung und Verwaltung der Stadt Köln im 14. und 15. Jahrhundert, 2 vol., Bonn.

Toebelmann, Kurt, 1911. Beiträge zur Geschichte des Maklerrechts nach süddeutschen Quellen, Diss. Göttingen, Stuttgart.

Verlinden, C., 1965. Markets and Fairs, in: Postan et al. (eds.), T*he Cambridge Economic History of Europe* Vol. 3, Cambridge: Cambridge University Press, 119-56.

Wee, Hermann van der, 1963, The Growth of the Antwerp Market and the European Economy, 3 volumes, Leuven, Den Haag.

Wee, Hermann va der , 2003. The Western European Woollen Industries, 1500-1750, in: David Jenkins (ed.), The Cambridge History of Western Textiles, Volume 1, Cambridge: Cambridge University Press.

Werveke, H. van, 1965, The Economic Policies of Governments: III. The Low Countries, in: in: M. M. Postan et al. (eds.), *The Cambridge Economic History of Europe, Volume 3*, 340-360.

Wooldridge, Jeffrey M., 2002. Econometric Analysis of Cross Section and Panel Data, Cambridge: The MIT Press.

Yavas, Abdullah, 1992. Marketmakers versus Matchmakers, *Journal of Financial Intermediation, 2 (1),* 33-58.

Yavas, Abdullah, 1994. Middlemen in Bilateral Search Markets*, Journal of Labor Economics 12 (3)*, 406-29.

8 Appendices

8.1 Appendix I – Proof of Theorems

Equilibrium of stage I

First, note that the competition among sellers does not depend on the number and size of the buyers. This is because, assuming each buyer fills his capacity from a single seller, each seller maximizes

$$\sum_{i \in B} \left(q_i \, \Pr(\text{i buys from j}) \left(E(\text{price}|\text{i buys from j}) - r_j \right) \right)$$

But since the buyers are ex-ante identical except for their capacities, the Probability and Price terms above are the same for each buyer, so we can rewrite this as

$$\left(\sum_{i \in B} q_i \right) \Pr(\text{i buys from j}) \left(E(\text{price}|\text{i buys from j}) - r_j \right)$$

Now $\sum_{i \in B} q_i$ is now simply a multiplicative constant, and doesn't impact sellers' maximization problem. Thus, everything we do below is as if there was a single buyer, who demands quantity 1.

Given the distribution chosen for each buyer's valuations, demand is logit: at a given set of prices $(p_1, \ldots, p_N)$, seller j gets market share

$$s_j = \frac{e^{(\mu_j - p_j)/\sigma}}{1 + \sum_{k \in N} e^{(\mu_k - p_k)/\sigma}}$$

(This is Q_j in the paper.) Taking derivatives, we find that

$$\frac{\partial s_j}{\partial p_j} = -\frac{1}{\sigma} s_j (1 - s_j)$$

and

$$\frac{\partial s_j}{\partial p_k} = \frac{1}{\sigma} s_j s_k$$

Note also that conditional on $v_j - p_j$ being the highest among all the sellers (and greater than the outside option), the expected value of $v_j - p_j$ minus the second-highest (or zero) is

$$\sigma \log \left(1 + \sum_{k \in N} e^{(\mu_k - p_k)/\sigma} \right) - \sigma \log \left(1 + \sum_{k \in N - \{j\}} e^{(\mu_k - p_k)/\sigma} \right)$$

Thus, seller j's expected profit is

$$\pi_j = (p_j - r_j)s_j + \alpha\sigma\left(\log\left(1 + \sum_{k\in N} e^{(\mu_k - p_k)/\sigma}\right) - \log\left(1 + \sum_{k\in N-\{j\}} e^{(\mu_k - p_k)/\sigma}\right)\right)$$

and so

$$\frac{\partial \pi_j}{\partial p_j} = s_j - \frac{1}{\sigma}(p_j - r_j)s_j(1 - s_j) - \alpha s_j = s_j\left((1-\alpha) - \frac{1}{\sigma}(p_j - r_j)(1 - s_j)\right)$$

So seller j's best-response is characterized by the first-order condition

$$\sigma(1-\alpha) = (p_j - r_j)(1 - s_j)$$

This first-order condition also characterizes the best-response conditions of a different game, where each seller's payoff function is

$$u_j = \sigma(1-\alpha)\ln(p_j - r_j) + \ln s_j$$

(This can be seen by differentiating this u_j with respect to p_j and noting that the first-order condition is the same.) Thus, the equilibria of our stage-I game are the same as the equilibria of this modified game.

We can further modify this game by putting an upper bound on the range of prices that can be best-responses, since

$$1 - s_j \geq s_0 = \frac{1}{1 + \sum_{j\in S} e^{v_j - q_j}} \geq \frac{1}{1 + \sum_{j\in S} e^{v_j}}$$

with v_j and q_j defined in the next section. Therefore,

$$\frac{\partial u_j}{\partial p_j} = \frac{\sigma(1-\alpha)}{p_j - r_j} - (1 - s_j) \leq \frac{\sigma(1-\alpha)}{p_j - r_j} - \frac{1}{1 + \sum_{j\in S} e^{v_j}}$$

and so when

$$p_j > r_j + \sigma(1-\alpha)\left(1 + \sum_{j\in S} e^{v_j}\right)$$

u_j is strictly decreasing. Thus, this gives us an upper bound on p_j, so we can rule out prices above this. We can similarly note that prices $p_j < r_j$ are dominated, and rule them out as well.

Next, note that this modified game is a supermodular game, indexed by $\sigma(1-\alpha)$. We differentiate and find that

$$\frac{\partial u_j}{\partial p_j} = \frac{\sigma(1-\alpha)}{p_j - r_j} - (1 - s_j)$$

This is clearly increasing in $\sigma(1-\alpha)$ on $p_j \geq r_j$. Further, it is increasing in $p_{j'}$, since s_j is increasing in $p_{j'}$. So we have a supermodular game with compact strategy spaces, which gives us a lattice structure on the set of equilibria. In particular, if there are multiple equilibria, there is a "biggest" and "smallest" equilibrium. Let $\overline{p}_j$ denote the strategy played by seller j in the "biggest" equilibrium, and $\underline{p}_j$ the strategy played by j in the "smallest"; then $\overline{p}_j \geq \underline{p}_j$ for every j.

Now, if $\overline{p}_j \geq \underline{p}_j$, then we know from the first-order conditions that s_j is higher in the "bigger" equilibrium than in the "smaller". Since this is true for every seller, we know that s_0 (the fraction of the market that does not buy at all) is lower in the "bigger" equilibrium than in the "smaller". But s_0 is increasing in each price, and all the prices are higher in the "bigger" equilibrium; all this is only possible if prices are the same in the two equilibria. Thus, the game has a unique equilibrium.

Since the game is supermodular and indexed by $\sigma(1-\alpha)$, and has a unique equilibrium, equilibrium prices are all increasing in $\sigma(1-\alpha)$, or increasing in σ and decreasing in α.

Since the "modified" game has the same equilibria as the original game, this holds for the original game as well.

It's clear from this first-order condition that when $\alpha = 1$, $p_j = r_j$ (sellers reveal their true valuations), and that when $\alpha < 1$, $p_j > r_j$ (sellers shade their valuations).

Calculating the effect of α on seller reports

First, let's get a bit of shorthand: with apologies for double-using q, define

$$v_j \equiv \frac{\mu_j - r_j}{\sigma}, \quad q_j \equiv \frac{p_j - r_j}{\sigma},$$

so that equilibrium is defined by

$$q_j(1 - s_j) = 1 - \alpha$$

and market shares and profits can be written as functions of q_j and v_j.

We begin with

$$q_j(1 - s_j) = 1 - \alpha$$

and differentiate with respect to α:

$$\begin{aligned}(1 - s_j)\tfrac{\partial q_j}{\partial \alpha} + q_j s_j(1 - s_j)\tfrac{\partial q_j}{\partial \alpha} - \textstyle\sum_{k \neq j} q_j s_j s_k \tfrac{\partial q_k}{\partial \alpha} &= -1 \\ (1 - s_j + q_j s_j)\,\tfrac{\partial q_j}{\partial \alpha} &= -1 + q_j s_j \textstyle\sum_{k \in N} s_k \tfrac{\partial q_k}{\partial \alpha}\end{aligned}$$

Define $\Delta = -\sum_{k \in N} s_k \frac{\partial q_k}{\partial \alpha}$, so

$$\begin{aligned}(1 - s_j + q_j s_j)\,\tfrac{\partial q_j}{\partial \alpha} &= -1 - q_j s_j \Delta \\ s_j \tfrac{\partial q_j}{\partial \alpha} &= -\tfrac{s_j}{1 - s_j + q_j s_j} - \tfrac{q_j s_j^2}{1 - s_j + q_j s_j}\Delta \\ \textstyle\sum_{k \in N} s_k \tfrac{\partial q_k}{\partial \alpha} &= -\textstyle\sum_{k \in N} \tfrac{s_k}{1 - s_k + q_k s_k} - \textstyle\sum_{k \in N} \tfrac{q_k s_k^2}{1 - s_k + q_k s_k}\Delta \\ \Delta &= \textstyle\sum_{k \in N} \tfrac{s_k}{1 - s_k + q_k s_k} + \textstyle\sum_{k \in N} \tfrac{q_k s_k^2}{1 - s_k + q_k s_k}\Delta \\ \Delta\left(1 - \textstyle\sum_{k \in N} \tfrac{q_k s_k^2}{1 - s_k + q_k s_k}\right) &= \textstyle\sum_{k \in N} \tfrac{s_k}{1 - s_k + q_k s_k} \\ \Delta\left(s_0 + \textstyle\sum_{k \in N} \tfrac{s_k(1 - s_k)}{1 - s_k + q_k s_k}\right) &= \textstyle\sum_{k \in N} \tfrac{s_k}{1 - s_k + q_k s_k} \\ \Delta &= \left(\textstyle\sum_{k \in N} \tfrac{s_k}{1 - s_k + q_k s_k}\right) \Big/ \left(s_0 + \textstyle\sum_{k \in N} \tfrac{s_k(1 - s_k)}{1 - s_k + q_k s_k}\right)\end{aligned}$$

and so

$$\frac{\partial q_j}{\partial \alpha} = -\frac{1}{1 - s_j + q_j s_j} - \frac{q_j s_j}{1 - s_j + q_j s_j} \frac{\sum_{k \in N} \frac{s_k}{1 - s_k + q_k s_k}}{s_0 + \sum_{k \in N} \frac{s_k(1 - s_k)}{1 - s_k + q_k s_k}}$$

Calculating the effect of α on overall welfare

Welfare is the sum of seller profits and buyer surplus. Conveniently, the $\log - \log$ terms cancel, and

$$W = \sum_{k\in N} \sigma q_k s_k + \sigma \log \left(1 + \sum_{k\in N} e^{v_k - q_k}\right)$$

so

$$\frac{\partial W}{\partial q_i} = \sigma s_i - \sigma q_i s_i (1 - s_i) + \sigma \sum_{k\neq i} q_k s_i s_k - \sigma s_i = -\sigma q_i s_i + \sigma s_i \sum_{k\in N} q_k s_k = \sigma s_i \left(\overline{q} - q_i\right)$$

where $\overline{q} = \sum_{k\in N} s_k q_k$. So

$$\frac{\partial W}{\partial \alpha} = \sigma \sum_{j\in N} s_j \left(\overline{q} - q_j\right) \left(-\frac{1}{1 - s_j + q_j s_j} - \frac{q_j s_j}{1 - s_j + q_j s_j} \frac{\sum_{k\in N} \frac{s_k}{1 - s_k + q_k s_k}}{s_0 + \sum_{k\in N} \frac{s_k(1-s_k)}{1-s_k+q_k s_k}} \right)$$

$$= \sigma \sum_{j\in N} \left\{ \begin{array}{c} -\frac{s_j \overline{q}}{1-s_j+q_j s_j} - \frac{q_j s_j^2 \overline{q}}{1-s_j+q_j s_j} \frac{\sum_{k\in N} \frac{s_k}{1-s_k+q_k s_k}}{s_0 + \sum_{k\in N} \frac{s_k(1-s_k)}{1-s_k+q_k s_k}} + \frac{s_j q_j}{1-s_j+q_j s_j} + \\ \frac{q_j^2 s_j^2}{1-s_j+q_j s_j} \frac{\sum_{k\in N} \frac{s_k}{1-s_k+q_k s_k}}{s_0 + \sum_{k\in N} \frac{s_k(1-s_k)}{1-s_k+q_k s_k}} \end{array} \right\}$$

Dropping the σ for now, this is

$$= \sum_{k\in N} \frac{s_k q_k}{1 - s_k + q_k s_k} - \sum_{k\in N} \frac{s_k}{1 - s_k + q_k s_k} \sum_{k\in N} s_k q_k$$

$$- \sum_{k\in N} \frac{q_k s_k^2}{1 - s_k + q_k s_k} \sum_{k\in N} s_k q_k \frac{\sum_{k\in N} \frac{s_k}{1-s_k+q_k s_k}}{s_0 + \sum_{k\in N} \frac{s_k(1-s_k)}{1-s_k+q_k s_k}} + \sum_{k\in N} \frac{q_k^2 s_k^2}{1 - s_k + q_k s_k} \frac{\sum_{k\in N} \frac{s_k}{1-s_k+q_k s_k}}{s_0 + \sum_{k\in N} \frac{s_k(1-s_k)}{1-s_k+q_k s_k}}$$

Multiplying through by $s_0 + \sum_k \frac{s_k(1-s_k)}{1-s_k+q_k s_k}$, we get

$$\left(s_0 + \sum_{k\in N} \frac{s_k(1 - s_k)}{1 - s_k + q_k s_k}\right) \sum_{k\in N} \frac{s_k q_k}{1 - s_k + q_k s_k}$$
$$- \left(s_0 + \sum_{k\in N} \frac{s_k(1 - s_k)}{1 - s_k + q_k s_k}\right) \sum_{k\in N} \frac{s_k}{1 - s_k + q_k s_k} \sum_{k\in N} s_k q_k$$

$$-\sum_{k\in N}\frac{q_k s_k^2}{1-s_k+q_k s_k}\sum_{k\in N}s_k q_k\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}+\sum_{k\in N}\frac{q_k^2 s_k^2}{1-s_k+q_k s_k}\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}$$

Combining the middle two terms gives

$$-\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}\sum_{k\in N}s_k q_k\left\{s_0+\sum_{k\in N}\frac{s_k(1-s_k)}{1-s_k+q_k s_k}+\sum_{k\in N}\frac{q_k s_k^2}{1-s_k+q_k s_k}\right\}$$

$$+\left(s_0+\sum_{k\in N}\frac{s_k(1-s_k)}{1-s_k+q_k s_k}\right)\sum_{k\in N}\frac{s_k q_k}{1-s_k+q_k s_k}+\sum_{k\in N}\frac{q_k^2 s_k^2}{1-s_k+q_k s_k}\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}$$

The terms inside the curly-brackets end up reducing to $s_0+\sum_k s_k=1$, so this is

$$-\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}\sum_{k\in N}s_k q_k+\left(s_0+\sum_{k\in N}\frac{s_k(1-s_k)}{1-s_k+q_k s_k}\right)\sum_{k\in N}\frac{s_k q_k}{1-s_k+q_k s_k}+$$
$$\sum_{k\in N}\frac{q_k^2 s_k^2}{1-s_k+q_k s_k}\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}$$

Combining the first and third terms leads us to

$$\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}\left\{\sum_{k\in N}\frac{q_k^2 s_k^2}{1-s_k+q_k s_k}-\sum_{k\in N}s_k q_k\right\}+\left(s_0+\sum_{k\in N}\frac{s_k(1-s_k)}{1-s_k+q_k s_k}\right)\sum_{k\in N}\frac{s_k q_k}{1-s_k+q_k s_k}$$

Now, since $q_k s_k=\frac{q_k s_k(1-s_k)+q_k^2 s_k^2}{1-s_k+q_k s_k}$, the piece inside the curly brackets reduces to $-\sum_k\frac{q_k s_k(1-s_k)}{1-s_k+q_k s_k}$, and so the whole expression is now

$$-\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}\sum_{k\in N}\frac{q_k s_k(1-s_k)}{1-s_k+q_k s_k}+\left(s_0+\sum_{k\in N}\frac{s_k(1-s_k)}{1-s_k+q_k s_k}\right)\sum_{k\in N}\frac{s_k q_k}{1-s_k+q_k s_k}$$

Now, since we are at an equilibrium, $q_k(1-s_k)=1-\alpha$, so this is

$$s_0\sum_{k\in N}\frac{s_k q_k}{1-s_k+q_k s_k}-(1-\alpha)\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}\sum_{k\in N}\frac{s_k}{1-s_k+q_k s_k}+$$
$$(1-\alpha)\sum_{k\in N}\frac{s_k(1-s_k)}{1-s_k+q_k s_k}\sum_{k\in N}\frac{s_k/(1-s_k)}{1-s_k+q_k s_k}$$

We can rewrite the sum of the last two terms as

$$(1-\alpha)\sum_{i\in N}\sum_{j\in N}\frac{s_i}{1-s_i+q_is_i}\frac{s_j}{1-s_j+q_js_j}\left(\frac{1-s_i}{1-s_j}-1\right)$$

When $i = j$, the term in parentheses, and therefore the summand, vanishes; so combining the two terms (i,j) and (j,i), we can rewrite the sum as coming from a given (i,j) pair and rewrite the sum as

$$\begin{aligned}
&(1-\alpha)\sum\sum_{i<j}\tfrac{s_i}{1-s_i+q_is_i}\tfrac{s_j}{1-s_j+q_js_j}\left(\tfrac{1-s_i}{1-s_j}-1+\tfrac{1-s_j}{1-s_i}-1\right)\\
=\;&(1-\alpha)\sum\sum_{i<j}\tfrac{s_i}{1-s_i+q_is_i}\tfrac{s_j}{1-s_j+q_js_j}\tfrac{(1-s_i)^2-2(1-s_i)(1-s_j)+(1-s_j)^2}{(1-s_i)(1-s_j)}\\
=\;&(1-\alpha)\sum\sum_{i<j}\tfrac{s_i}{1-s_i+q_is_i}\tfrac{s_j}{1-s_j+q_js_j}\tfrac{((1-s_i)-(1-s_j))^2}{(1-s_i)(1-s_j)}\\
=\;&(1-\alpha)\sum\sum_{i<j}\tfrac{s_i}{1-s_i+q_is_i}\tfrac{s_j}{1-s_j+q_js_j}\tfrac{(s_j-s_i)^2}{(1-s_i)(1-s_j)}\quad\geq\quad 0
\end{aligned}$$

so $\frac{\partial W}{\partial\alpha} > 0$ as claimed.

Theorem 4

Note first that since the entire expression $\frac{\partial W}{\partial\alpha}$ has a σ term in front of it, it is likely to be increasing in σ holding all other variables fixed. However, since σ also impacts the equilibrium values of the other terms in the expression, this is difficult to prove. Thus, we instead give the simpler result: holding fixed $\frac{\mu_k-r_k}{\sigma}$ (or, holding fixed the fraction of buyers with whom each seller has possible gains from trade), total surplus is more sensitive to α as σ rises.

The "holding fixed" allows us to change σ – making tastes more volatile in absolute terms, and making the goods better substitutes for each other – while holding constant the fraction of buyers with whom each seller has potential gains from trade. (If we didn't do this normalization, then increasing σ has the effect of pushing μ_k and r_k closer together in effective terms, that is, pushing the seller's reservation price toward that of the average buyer.)

Once we make this adjustment, we can show that $\frac{\partial W}{\partial\alpha}$ is increasing in σ, that is, that the absolute dollar effect of α on overall surplus (which we already proved is positive) is higher for higher σ.

To see this, first note that at a given α, the effect of proportional increases to σ and $\mu_k - r_k$ is an increase in each seller's equilibrium markup $p_k - r_k$ by the same proportion. To see this, we rewrite the first-order condition of a typical seller k as

$$\frac{p_k - r_k}{\sigma}\left(1 - \frac{\exp\left(\frac{\mu_k - r_k}{\sigma} - \frac{p_k - r_k}{\sigma}\right)}{1 + \sum_j \exp\left(\frac{\mu_j - r_j}{\sigma} - \frac{p_j - r_j}{\sigma}\right)}\right) = 1 - \alpha$$

An increase in σ, accompanied by proportional increases in $p_k - r_k$ and $\mu_k - r_k$, leaves the entire left-hand side unchanged. Since equilibrium is equivalent to each seller's first-order conditions holding with equality, such a change (starting at an equilibrium given initial values of σ and μ_k) leaves us in an equilibrium given the final values of σ and μ_k. Such a change therefore also leaves equilibrium market shares (alternatively Q_k and s_k) unchanged.

Returning to the proof that total surplus is increasing in α, we found that

$$\frac{\partial W}{\partial \alpha} = \sigma \left\{ \sum_{k \in N} \frac{q_k s_k}{1 - s_k + q_k s_k} - (1 - \alpha)\left(\sum_{k \in N} \frac{s_k}{1 - s_k + q_k s_k}\right)^2 \Big/ \left(s_0 + \sum_k \frac{s_k(1 - s_k)}{1 - s_k + q_k s_k}\right)\right\}$$

where $q_k = \frac{p_k - r_k}{\sigma}$, where we already established that the term inside the curly-brackets is positive. An increase in σ, accompanied by a proportional change in $\mu_k - r_k$, leads to a proportional change (in equilibrium) in $p_k - r_k$ and no change to equilibrium market shares. So the term within curly brackets does not change at all; and so $\frac{\partial W}{\partial \alpha}$ is therefore increasing in σ, as claimed.

(In fact, $\frac{\partial W}{\partial \alpha}$ increases linearly in σ – that is, a doubling of σ (accompanied by a doubling of $\mu_k - r_k$ and a move to new equilibrium prices) exactly doubles the (absolute) sensitivity of total surplus to α – just as it exactly doubles the total equilibrium surplus itself. Therefore, in *relative* terms, total surplus remains equally sensitive to α at various levels of σ. However, it is more natural to think about the problem in absolute (dollar) terms, rather than relative (percentage) ones.)

8.2 Appendix II - Extensions to the Basic Model

A number of simplifying assumptions were made when formulating the basic model; it may be helpful to consider the effect of relaxing each of them.

Scarce Goods

We assumed above that each seller had a "sufficient" supply of goods, that is, that no seller was influenced by the possibility of running out of his goods. Holding everything else constant, a scarcity of one seller's goods should lead him to raise his price, for two reasons. First, there is less gain from pricing low, since he cannot benefit from a large demand for his good; and second, one would expect the scarcity to increase the seller's reservation value for unsold goods, since once the goods are sold, he has nothing to offer at the next town.

(Recall that in the basic model, the seller perceived all buyers as a single buyer, and was concerned only with his expected market share. With scarce goods, this simplification is no longer valid. For example, suppose there were 15 buyers who were ex-ante identical and each interested in 1 unit, and that seller s_j had priced in such a way that he expected to sell to each buyer with probability Q_j. Without scarcity, the expected demand for his goods would be

$$\sum_{z=0}^{15} \binom{15}{z} Q_j^z (1-Q_j)^{15-z} z = 15Q_j$$

However, if the seller has only 3 units to sell, then his expected demand at the same price would be

$$\sum_{z=0}^{15} \binom{15}{z} Q_j^z (1-Q_j)^{15-z} \min\{3, z\}$$

So for instance, if $Q_j = 0.20$, that is, the seller expected to be able to sell to one-fifth of the 15 buyers but was limited to selling 3 units, his expected sales would be only 2.4 units rather than 3. In addition to the expected demand being lower, the price-elasticity would be lower (since the expected gain in volume due to a price cut would be 0 whenever he was already at capacity), encouraging the seller to price higher.)

As it happens, the game as specified is a supermodular game between all the sellers, so an increase in one seller's price would be met with price increases from the other sellers, with all the "feedback loops" reinforcing higher prices. Thus, if one or more sellers had scarce goods, the stage-I game would still have a unique equilibrium, with all of the sellers stating higher valuations. We expect the qualitative part of Theorem 2, as well as Theorem 3 and Conjecture 1, would still hold: sellers would still report closer to the truth as α increased, leading to higher welfare, with the effect being more significant at higher σ.

Uncertainty Among the Sellers

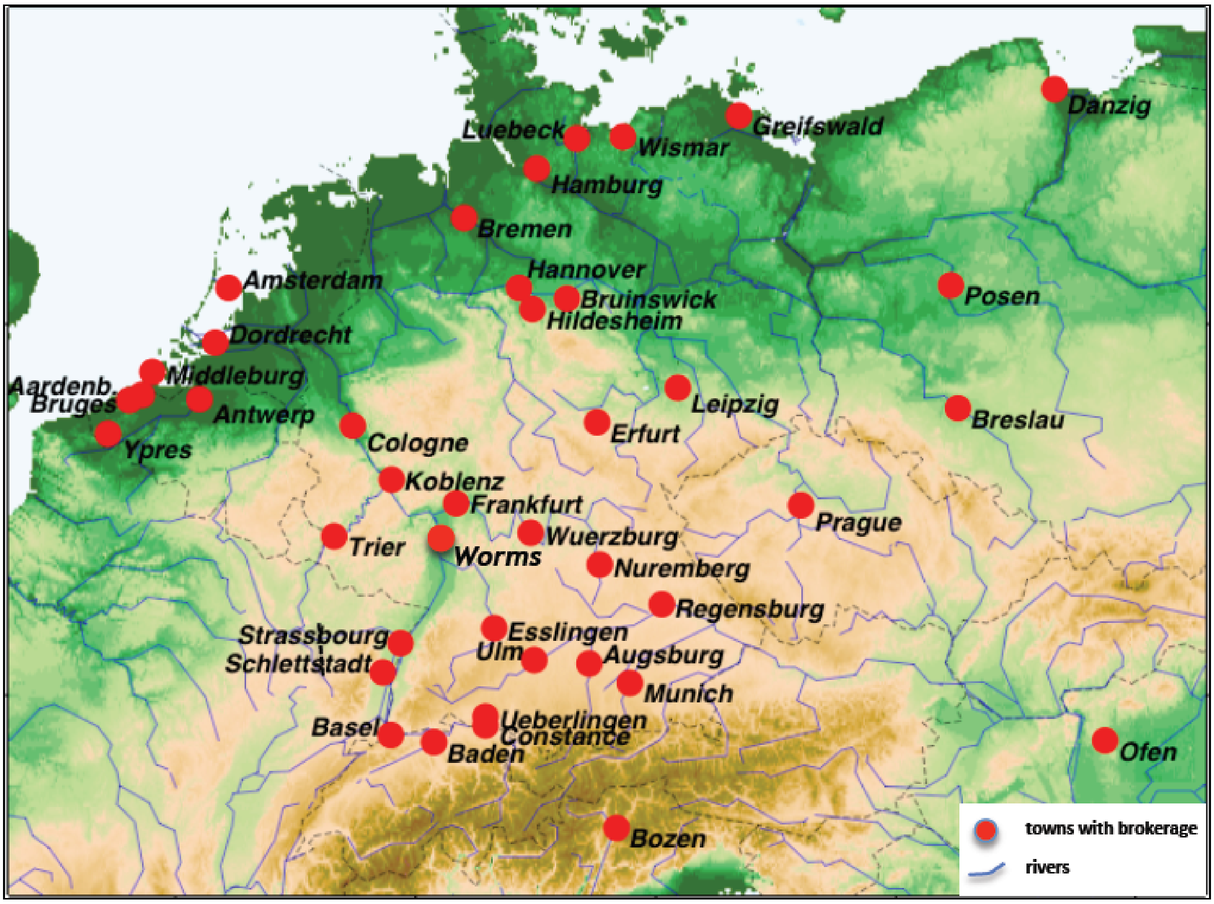
We assumed above that both the quality (μ_j) and reservation value (r_j) of the various sellers' goods was common knowledge among the sellers, and thus that r_j was hidden only from the broker and the sellers. If the different sellers' reservation values r_j were not known to each other, that is, each seller knew only knew the prior distributions of the other sellers' reservation values, the game would be much like an auction among the sellers, but with the probability of "winning" a continuous function of the sellers' bids. We expect the main qualitative results to still hold, although the analysis would be more difficult. If the sellers were *also* uninformed about the quality of the other sellers' goods – that is, both μ_j and r_j were private information to each seller – then the game would have "two-dimensional types," and we are far less confident that the results would go through.

Uncertainty on Both Sides

We assumed above that the broker was already aware of each buyer's taste for each type of good $v_{i,j}$, and had only to ascertain each seller's reservation value p_j. This assumption was made partly for historical reasons – the broker generally came from the town, and was a local expert in that particular good – and also to simplify the analysis. If the buyers' particular tastes were also private information, and needed to be reported to the broker, then we would face a more typical two-sided matching problem. We would expect each side to be "more truthful" when the broker's choice of a match (here represented by α) favored their side more: we would expect truthful revelation among buyers expecting the buyer-optimal match, and among sellers expecting the seller-optimal match, with each side "shading" their preferences more as the expected outcome moved in the other direction. (Truthful revelation does not always occur in two-sided matching models; however, the additional restrictions we have placed on preferences would likely lead to it being optimal.) With both sides reporting preferences, the welfare effect of α would be ambiguous, and might well depend on which side there was *more* uncertainty about. (With two-sided uncertainty, there might be cases where total welfare was highest at interior α, and other cases where welfare was highest at either $\alpha = 0$ or $\alpha = 1$. Similar to the role of σ in parameterizing the ex-ante distribution of buyer tastes, we would need a similar measure to parameterize the ex-ante variation in sellers' reservation prices; the relative levels of σ and this parameter would likely determine where the optimal α lay.)

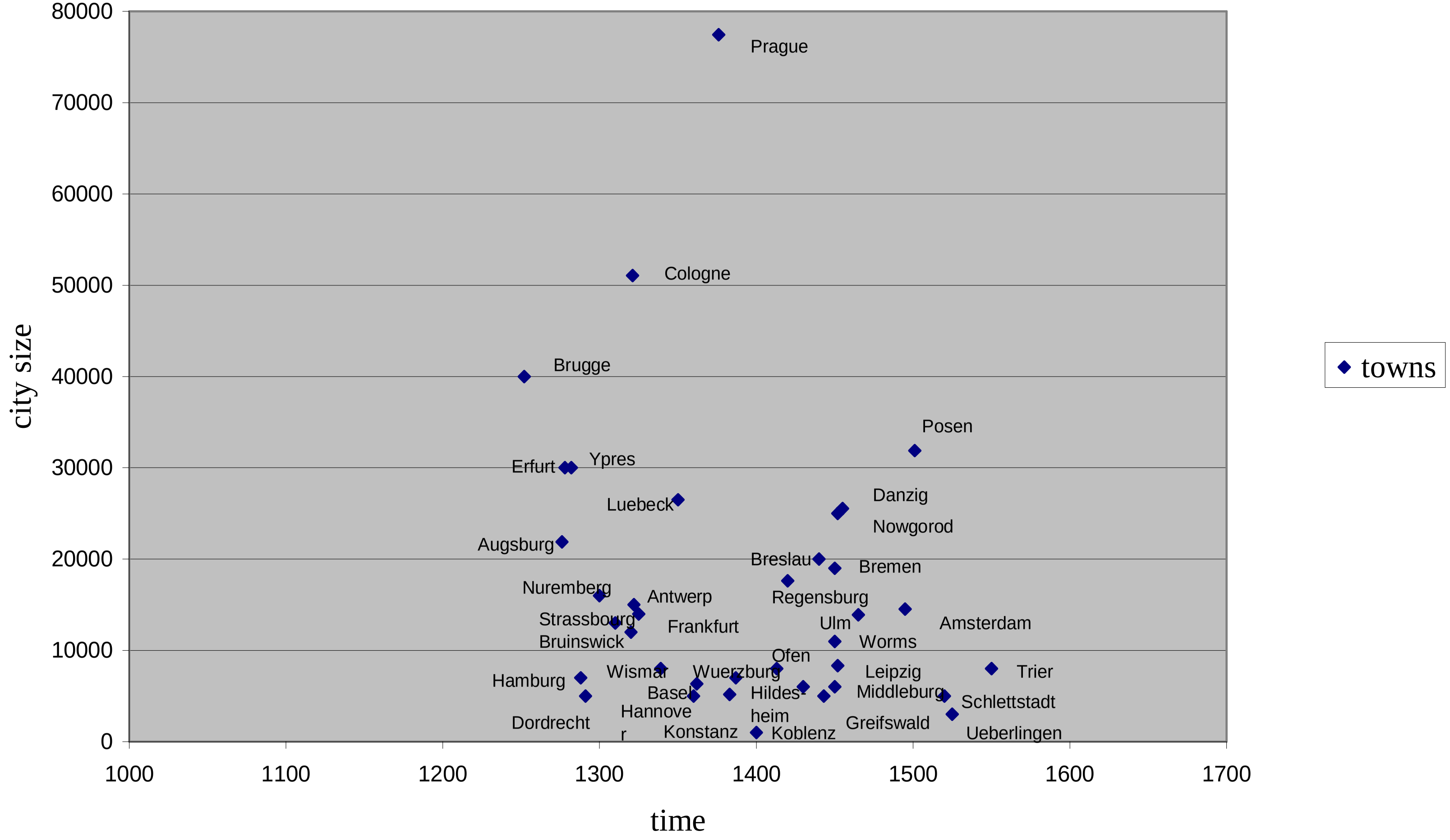
8.3 Appendix III: Tables and Figures

Figure 1 – Towns with Brokerage Regulations



Note: We also found brokerage regulations for Nowgorod, but we restricted the map to the core area under study in order to increase clarity.

Figure 2 - First Documented Brokerage Regulations



Note: We have no population size for the first evidence in Aardenburg (1280), Baden (1518) , and Bozen (1600).

Table 1 - Most Frequent Product Genres Identified

product genre	number of obs.	number of towns	% shares of towns
wine/ beer	62	16	47,1
grain	47	14	41,2
fish	50	23	67,6
cattle/ meat	32	10	29,4
oil/ fat	48	17	50,0
horses	54	15	44,1
spices/ coloring/ similar	57	17	50,0
fur/ skin/ leather	50	17	50,0
raw textile	74	20	58,8
cloth	72	19	55,9
metal	51	16	47,1
construction material	50	12	35,3
finance	71	15	44,1
property	39	13	38,2

Notes: The product genre spices/ coloring/ similar also containts salt, honey, and sugar. 34 out of 42 towns depict product information. 100% is based on 34 towns.

Table 2 - Single Brokerage Regulations

single rules	number of obs.	number of towns	% of towns
unit_fees	352	26	59,5
value_fees	191	24	56,1
private_business_constraint	406	30	71,4
forced_brokerage	53	9	21,4
only_brokers	561	32	78,0
promote_facilitate_trade	152	11	26,2
reduce_damage_create_order	108	13	31,0
utility_citizens	167	11	26,2
utility_town	135	11	26,2
equal_treatment	197	22	52,4

Notes: The total number of regulations found is 1106, the total number of towns 42. 100% is based on all 42 towns. Due to the fragmentary quality of the sources percentage ranges above 50% can be interpreted as very high outcomes.

Table 3 - Combinations of Brokerage Regulations Identified

combinations of rules	number of obs.	% of all obs.	number of towns
matchmaking_unit fees	208	44,3	17
matchmaking_value_fees	109	23,2	16
matchmaking_without_pb_const	89	18,9	13
forced_matchmaking	35	7,4	3
matchmaking_without_fixed_fees	20	4,3	10
matchmaking_without_licensing	9	1,9	8
total number of combinations	470	100%	-

Notes: The total number of observations is 1106, 452 depict combinations of rules based on the 4 in the text characterized rules. Thus the total number of combinations of rules is 452 which equals 100%.

Table 4 – Product Characteristics of the Two Matchmaking Designs

characteristics	matchmaking_with_unit_fees	Matchmaking_with_value_fees
wine_beer	22	1
grain	18	2
fish	12	1
cattle_meat	7	1
oil_fat	12	1
horses	0	19
spices_similar	19	8
fur_skin_leather	14	10
raw_textile	24	20
cloth	18	20
metal	18	5
construction_material	22	1
finance	3	10
property	0	8

-Table -5-

variables	(1) matchmaking	(2) matchmaking units vs values	(3) matchmaking with units	(4) matchmaking with values	(5) private business constraint	(6) unit vs value fees
wine_beer	0.153*	0.117***	0.213**	-0.014	0.169*	0.285***
	(0.082)	(0.044)	(0.108)	(0.009)	(0.098)	(0.040)
grain	0.064	0.108***	0.092	-0.015	0.263***	0.248***
	(0.075)	(0.033)	(0.065)	(0.009)	(0.074)	(0.047)
fish	0.060	0.102***	0.136	-0.017	0.073	0.291***
	(0.060)	(0.038)	(0.089)	(0.010)	(0.079)	(0.045)
cattle_meat	0.076	0.072**	0.082	-0.005	0.086	0.219***
	(0.079)	(0.036)	(0.068)	(0.018)	(0.143)	(0.072)
oil_fat	0.020	0.115***	0.034	-0.017	0.002	0.323***
	(0.046)	(0.039)	(0.034)	(0.010)	(0.087)	(0.041)
spices_similar	0.096**	0.038	0.030	0.006	0.255***	0.098
	(0.046)	(0.056)	(0.034)	(0.018)	(0.084)	(0.085)
horses	0.158	-	-	0.199*	0.151	-
	(0.136)	-	-	(0.103)	(0.125)	-
cloth	0.117	-0.928***	0.057	0.122*	0.283**	-0.368
	(0.083)	(0.062)	(0.036)	(0.064)	(0.114)	(0.231)
raw_textile	0.230*	-0.244	0.133	0.055*	0.222**	-0.368
	(0.123)	(0.529)	(0.090)	(0.030)	(0.112)	(0.231)
fur_skin_leather	0.190***	0.030	0.020	0.011	0.139**	0.112
	(0.065)	(0.105)	(0.078)	(0.019)	(0.062)	(0.113)
metal	0.018	0.066	0.069	-0.006	0.000	0.120
	(0.055)	(0.045)	(0.055)	(0.009)	(0.096)	(0.081)
construction	0.084	0.160	0.133**	-0.018	0.189**	0.244***
	(0.095)	(0.054)	(0.064)	(0.011)	(0.069)	(0.068)
finance	0.194	-0.877***	-0.028	0.038*	0.187	-0.520***
	(0.118)	(0.103)	(0.038)	(0.021)	(0.120)	(0.243)
property	-0.037	-	-	0.032	-0.062	-0.497***
	(0.051)	-	-	(0.021)	(0.069)	(0.160)
fair	0.429***	0.105	0.125	0.032	0.443**	0.007
	(0.124)	(0.100)	(0.068)	(0.030)	(0.150)	(0.93)
utility_ citiziens	0.477***	0.433**	0.183	0.056	0.482***	0.046
	(0.158)	(0.173)	(0.126)	(0.061)	(0.121)	(0.146)
utility_town	0.072	-0.785***	0.053	0.020	0.133	-0.247*
	(0.157)	(0.150)	(0.063)	(0.030)	(0.226)	(0.146)
promote_trade	0.695***	0.999***	0.576***	0.060	0.507**	0.381***
	(0.193)	(0.000)	(0.181)	(0.055)	(0.196)	(0.062)
create_order	0.012	0.455**	0.027	0.006	-0.023	0.203**
	(0.173)	(0.210)	(0.067)	(0.028)	(0.154)	(0.086)
period	-0.002***	-0.005**	-0.001***	-0.0001	-0.003***	-0.002**
	(0.001)	(0.002)	(0.0003)	(0.0001)	(0.001)	(0.001)
time	0.001**	0.004**	0.0001***	0.000	0.001*	0.002*
	(0.001)	(0.002)	(0.0004)	(0.000)	(0.001)	(0.001)
time_perw	-0.016	-0.169***	-0.042**	0.008	0.051	-0.233
	(0.035)	(0.054)	(0.019)	(0.006)	(0.066)	(0.151)
logdist_north	-0.294***	1.870***	-0.093*	-0.054	-0.505***	0.322*
	(0.113)	(0.674)	(0.051)	(0.029)	(0.126)	(0.174)
logdist_west	0.012	0.300**	0.004	0.0002	-0.096***	-0.023
	0.009)	(0.122)	(0.004)	(0.001)	(0.012)	(0.020)
logdist_nl	-0.011	0.345**	-0.009	0.002	0.019	0.006
	(0.012)	(0.143)	(0.006)	(0.002)	(0.019)	(0.018)
logdist_sea	0.062**	-0.345***	0.005	0.013*	0.104***	-0.83**
	(0.026)	(0.143)	(0.012)	(0.007)	(0.030)	(0.037)
logdist_nextc	-0.061**	0.063	0.007	-0.008	-0.071*	0.058*
	(0.025)	(0.047)	(0.008)	(0.007)	(0.042)	(0.035)
logpop	-0.053	0.153	-0.043	-0.003	-0.030	-0.187**
	(0.057)	(0.095)	(0.029)	(0.007)	(0.059)	(0.086)
log pseudo- likelihood	-283.49	-52.14	-198.60	-174.70	-403.76	-178.61
number of obs.	1059	228	974	1059	1062	438
Wald Chi2	879.28	-	258757.69	158354.62	8917.04	-
prob> Chi2	0	-	0	0	0	-
pseudo R2	0.54	0.65	0.59	0.49	0.42	0.38

Notes:* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in brackets.

Table 6 – Predictions and Outcomes

	(1)	(2)	(3)	(4)
	matchmaking design		buyer- or seller- friendly design	
variables	prediction	empirical findings	prediction	empirical findings
wine_beer	implementation yes	confirm	buyer-friendlier	confirm
grain	yes	weakly confirm	buyer-friendlier	confirm
fish	yes	reject	buyer-friendlier	confirm
cattle_meat	yes	reject	buyer-friendlier	confirm
oil_fat	yes	reject	buyer-friendlier	confirm
spices_similar	yes	confirm	seller-friendly	-
horses	no	confirm	seller-friendly	confirm
cloth	yes	confirm	seller-friendly	confirm
raw_textile	yes	confirm	buyer/ seller friendly	confirm
fur_skin_leather	yes	weakly confirm	seller-friendly	-
metal	no	confirm	buyer-friendlier	confirm
construction	no	weakly confirm	buyer-friendlier	confirm
property	no	confirm	seller-friendlier	confirm
finance	yes	reject	seller-friendlier	confirm
equal_treatment	yes	confirm	buyer-friendlier	weakly confirm
utility_citizens	yes	confirm	buyer-friendlier	confirm
utility_town	yes	reject	seller-friendly	confirm
promote_trade	yes	confirm	no predictions	buyer-friendlier
create_order	yes	reject	no predictions	buyer-friendlier
period	earlier more likely	confirm	earlier buyer-friendlier	confirm
time	learning effects yes	confirm	no predictions	stronger learning effects in the buyer-friendlier design
time_perw	learning effects over time yes	weakly confirm	no predictions	stronger learning effects in the buyer-friendlier design
logpop	no predictions	-	no predictions	-
logdist_west	implementation closer to the west	reject	seller-friendly closer to the west	confirm
logdist_north	implementation closer to the north	confirm	seller-friendly closer to the north	confirm
logdist_nl	implementation closer to the NL	reject	seller-friendly closer to the NL	confirm
logdist_sea	implementation closer to the sea	reject	no predictions	buyer-friendlier closer to the sea
logdist_nextc	yes	confirm	seller-friendly design more likely the closer to the next city	-

Diskussionsbeiträge
des Fachbereichs Wirtschaftswissenschaft
der Freien Universität Berlin

2010

2010/1 BÖNKE, Timm / Sebastian EICHFELDER
Horizontal equity in the German tax-benefit system
Economics

2010/2 BECKER, Sascha / Dieter NAUTZ
Inflation, Price Dispersion and Market Integration through the Lens of a Monetary Search Model
Economics

2010/3 CORNEO, Giacomo / Matthias KEESE / Carsten SCHRÖDER
The Effect of Saving Subsidies on Household Saving
Economics

2010/4 BÖNKE, Timm / Carsten SCHRÖDER / Clive WERDT
Compiling a Harmonized Database from Germany's 1978 to 2003 Sample Surveys of Income and Expenditure
Economics

2010/5 CORNEO, Giacomo
Nationalism, Cognitive Ability, and Interpersonal Relations
Economics

2010/6 TERVALA, Juha / Philipp ENGLER
Beggar-Thyself or Beggar-Thy-Neighbour? The Welfare Effects of Monetary Policy
Economics

2010/7 ABBASSI, Puriya / Dieter NAUTZ
Monetary Transmission Right from the Start: The (Dis)Connection Between the Money Market and the ECB's Main Refinancing Rates
Economics

2010/8 GEYER, Johannes / Viktor STEINER
Public pensions, changing employment patterns, and the impact of pension reforms across birth cohorts
Economics

2010/9 STEINER, Viktor
Konsolidierung der Staatsfinanzen
Economics

2010/10 SELL, Sandra / Kerstin LOPATTA / Jochen HUNDSDOERFER
Der Einfluss der Besteuerung auf die Rechtsformwahl
FACTS

2010/11 MÜLLER, Kai-Uwe / Viktor STEINER
Labor Market and Income Effects of a Legal Minimum Wage in Germany
Economics

2010/12 HUNDSDOERFER, Jochen / Christian SIELAFF / Kay BLAUFUS / Dirk KIESEWETTER / Joachim WEIMANN
The Name Game for Contributions – Influence of Labeling and Earmarking on the Perceived Tax Burden
FACTS

2010/13 MUCHLINSKI, Elke
Wie zweckmäßig ist das Vorbild der Physik für ökonomische Begriffe und Metaphern
Economics

2010/14 MUCHLINSKI, Elke
Metaphern, Begriffe und Bedeutungen – das Beispiel internationale monetäre Institutionen
Economics

2010/15 DITTRICH, Marcus und Andreas Knabe
Wage and Employment Effects of Non-binding Minimum Wages
Economics

2010/16 MEIER, Matthias und Ingo Weller
Wissensmanagement und unternehmensinterner Wissenstransfer
Management

2010/17 NAUTZ, Dieter und Ulrike Rondorf
The (In)stability of Money Demand in the Euro Area: Lessons from a Cross-Country Analysis
Economics

2010/18 BARTELS, Charlotte / Timm Bönke
German male income volatility 1984 to 2008: Trends in permanent and transitory income components and the role of the welfare state
Economics

2010/19 STEINER, Viktor / Florian Wakolbinger
Wage subsidies, work incentives, and the reform of the Austrian welfare system
Economics

2010/20 CORNEO, Giacomo
Stakeholding as a New Development Strategy for Saudi Arabia
Economics

2010/21 UNGRUHE, Markus / Henning KREIS / Michael KLEINALTENKAMP
Transaction Cost Theory Refined – Theoretical and Empirical Evidence from a Business-to-Business Marketing Perspective
Marketing

2010/22 POWALLA, Christian / Rudi K. F. BRESSER
Performance Forecasts in Uncertain Environments: Examining the Predictive Power of the VRIO-Framework
Strategic Management

2010/23 KREMER, Stephanie
Herding of Institutional Traders: New Evidence from Daily Data
Economics

2010/24 ROSTAM-AFSCHAR, Davud
Entry Regulation and Entrepreneurship
Economics

2010/25 DECKER, Carolin / Rudi K. F. BRESSER / Thomas MELLEWIGT
Strategic Or Status Quo-Preserving Business Exit: (How) Do CEO Turnover and Succession Mattter?
Strategic Management

2010/26 NAUTZ, Dieter / Jan SCHEITHAUER
Monetary Policy Implementation and Overnight Rate Persistence
Economics

2010/27 BÖRNER, Lars / John William HATFIELD
The Economics of Debt Clearing Mechanisms
Economics

2010/28 KNABE, Andreas / Alexander PLUM
Low-Wage Jobs – Stepping Stone or Poverty Trap?
Economics

2010/29 SCHMIDT, Sandra / Dieter NAUTZ
Central Bank Communication and the Perception of Monetary Policy by Financial Market Experts
Economics

2010/30 BÖNKE, Timm / Nima MASSARRAT-MASHHADI / Christian SIELAFF
Charitable Giving in the German Welfare State: Fiscal Incentives and Crowding Out
Economics

2010/31 BÖRNER, Lars / Daniel QUINT
Medieval Matching Markets
Economics